Central Marine Fisheries Research Institute, Kochi
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CMFRI

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Annual Report
2007-08

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ICAR

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CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
Indian Council of Agricultural Research
Post Box No. 1603, Ernakulam North P.O., Cochin - 682 018, India

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CMFRI Annual Report 2007-2008

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Front Cover : The Indian oil sardine (*Sardinella longiceps*) which has become the dominant resource in many maritime states is a subject of detailed investigations on its biology and phenology

Back Cover : The fish cage farm deployed in the Bay of Bengal off Visakhapatnam coast is India's first offshore cage farm

Cover design & Layout : - K. S. Mohamed and P. R. Abhilash

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PREFACE

I have great pleasure in presenting the Annual Report of Central Marine Fisheries Research Institute for the year 2007-08. This year has been a remarkable year for CMFRI. The Institute celebrated its Diamond Jubilee with a series of outreach programmes commemorating its past and present achievements. The celebrations culminated with the visit of the Hon'ble Agriculture Minister Shri Sharad Pawar to the Institute alongwith the Director General, ICAR, Dr. Mangala Rai. Befittingly, the CMFRI also won the coveted Sardar Patel Outstanding Institute Award for the year 2007 from ICAR. This award which is the outcome of past and present achievements of the Institute scientists serves to refocus and re-dedicate ourselves to the task of fulfilling the mandate of the Institute.

This year too, my colleagues have put in tremendous effort to make significant and meaningful achievements in the areas of marine capture fisheries, impact of climate change, deep-sea resources, data archaeology, marine environment, resource conservation, marine biodiversity, mariculture, socio-economics, technology transfer and marine biotechnology. This annual report gives a brief about outcomes from all research projects executed by CMFRI, besides measurable outputs like publications and technologies transferred to end-users.

I place on record the institute's gratitude to Dr. Mangala Rai, Director General, Dr.S. Ayyappan, Dy. Director General (Fy.) and Dr.A.D. Diwan, Asst. Director General (M. Fy.) for providing their unstinted support in managing and administering the Institute and its research.

I hope that the contents of this annual report would be useful to researchers, policy makers, students and others working for the wellbeing of the marine fisheries sector.

G. Syda Rao
Director

31st July, 2008

Executive Summary

The marine fish production of the country grew by 6.3% to reach 2.8 million tonnes. The production of *Sardinella longiceps* which was a major resource showed an increase in catch crossing 5 lakh tonnes. Kerala followed by Gujarat were the top states in marine fish production, and southwest followed by northwest were the top regions. The estimated value of marine fish landings at primary level increased by 11% to Rs. 14,721 crores and the value of fish at last sales increased by 12 % to Rs.24,934 crores.

The long term potential yield (LTPY) and average long term Yield (ALTY) of marine fish landings of Kerala was estimated as 6.63 lakh tonnes while the current yield was 6.19 lakh tonnes, indicating little scope for increase in landings from the current fishing grounds. In Lakshadweep, catch rates in the pole and line fishery for tunas was poor during 2007 at both Minicoy and Agatti. A non-equilibrium surplus production model (Schaefer's) was fitted for Tamil Nadu catch and effort data using a genetic algorithm. Results indicated that there is scope to increase effort on small pelagics such as oil sardine, which has emerged as the major fishery in Tamil Nadu. In Andhra Pradesh, total marine fish landings showed a marginal decline by 3.8%, mainly due to the decline in catches of sardine, mackerel and ribbonfish. In Gujarat, marine fish production continued its declining trend (current year 6.5% decrease). A noteworthy feature was the revival of the 'ghol' and 'koth' fishery and the emergence of a new fishery for the deap sea squid (*Sthenoteuthis oualaniensis*). In Maharashtra, the estimated marine fish landings increased by 4.6% to 3.19 lakh tonnes. The oil sardine and mackerel catches showed 5-fold and 2.4 fold increase respectively, the latter is specifically unprecedented in northern Maharashtra coast.

In Karnataka, where the annual catch showed a 21% increase, 17 species stocks were exploited above the optimum level, 6 at optimum level and only 2 stocks were exploited below optimum level. An assessment of low-value by-catch (LVB) and discards in trawl fisheries were made from Veraval, Mumbai, Mangalore, Calicut, Kochi, Tuticorin, Mandapam, Chennai and Visakhapatnam. An estimate of economic loss caused due to fishing for juvenile shrimp *Metapenaeus dobsoni* was also made. A trophic model of the northwest coast (NWC) ecosystem was developed. Several ecological ratios indicated that the NWC ecosystem is an immature and developing one and the high mean trophic level (3.49) indicated an ecosystem dominated by predators.

DNA analysis revealed that Yellowfin tuna stocks along the southwest coast and international waters were genetically homogeneous. Lobster conservation was popularized among fishers in Gujarat, Maharashtra and Tamil Nadu through dissemination of posters and pamphlets in vernacular languages. The biodiversity of deep sea demersal finfish in North Andaman was investigated and several biodiversity indices were calculated.

Knowledge on impact and vulnerability of marine fishes and fisheries to climate change was further advanced during the year. The Indian mackerel is able to adapt to rise in sea temperature by extending its distribution towards northern latitudes, similar to oil sardine, and also by descending to depths. The carbon footprint of marine fishing boats was determined and an inventory on vulnerability of coastal fishing villages to sea level rise was made.

Using data archaeology, the impact of fisheries on the biodiversity of marine fish resources of southwest coast of India was assessed. From catch data of oil sardine and mackerel from 1926-2005, it was found that the revival of oil sardine fishery in 1950s and late 1990s coincided with heavy rainfall and the presence of an optimal environmental window (OEW).

The impact of domestic sewage and other anthropogenic activities were studied in 8 coastal cities. Specific attention was placed on the presence of plastics in fishing grounds and beaches.

The distributional shift in small pelagics was studied in relation to environmental changes. Fish otolith chemistry, particularly Sr:Ca ratio was found to be a very useful tool in identifying fish stocks. The final report of the project on marine mammals highlighted the (a) temporal and spatial distribution, (b) incidental kills in fishing gears, (c) molecular taxonomy and (d) trace metal and pesticide loads in tissues of marine mammals.

Under the benefit-cost analysis of marine fisheries business project, the cost and earning profile of 10 craft-gear combinations in Kerala were compared. In SDF trawling, the capital productivity was more efficient at Visakhapatnam (0.62) than at Kakinada (0.64). The amazing socio-technological changes in Alamthala village in south Tamil Nadu was documented and compared with that in 1982-83. In impact assessment of fisheries research, the NAAS rating of research papers of CMFRI were compared for the period 1991-2006.

Through underwater line intercept transect surveys, the diversity of coral reefs of southern India was documented. The total coral cover in Enayam was 3%, while at Vizhinjam it was 16%. Both 'Thallumadi' and 'Shinguvalai' were observed to cause destruction of sponges and lobsters and echinoderms, respectively in the Gulf of Mannar. Studies on specific and infraspecific diversity of carangids of the Indian seas was completed during the year with the documentation of 61 species belonging to 21 genera.

In mariculture seed production, *Penaeus semisulcatus* and *Portunus pelagicus* seeds were produced in the hatchery and sea ranched. Spawning, hatching and larval rearing could be achieved for the first time with the crucifix crab *Charybdis feriatus*. The farmed mussel production showed a 22% decrease and the carrying capacity of Sattar Island in Central Kerala for mussel farming was determined. Capture based finfish culture using cages and pens were initiated in Vizhinjam and Calicut.

In a concerted effort to develop technologies for farming marine finfish, broodstock development of 5 species of food fishes (*Rachycentron canadum* – cobia; *Epinepheles malabaricus* and *E. polyphekadion* – Grouper; *Siganus canaliculatus* – Rabbit fish; *Trachinotus blotchi* – pompano), were attempted during the year. Broodstock development and breeding of the marine ornamental, saphire devil, *Chysiptera cyanae* and the Redhead Dottyback, *Pseudochromis dilectus* were achieved during the year. Besides, larval rearing techniques were standardized for the maroon clown *Premnas biaculeatus*.

In marine biotechnology, 2 feeds for ornamental fishes were developed and a comparative assessment made with that of an imported feed. Molecular genetic profiling and development of biomarkers were achieved for 2 species of endangered marine catfishes. Seven successful cell culture systems have been developed from different tissues of the grouper *E. malabaricus.* A DNA microarray chip has been developed through a combined multiplex PCR for detection of 3 finfish and shellfish pathogens.

The Institute scientists were able to publish 15 books and special publications; 65 research papers in peer reviewed journals and a number of technical and popular articles on important themes in marine fisheries and mariculture. The commendable achievements of scientists were rewarded with 8 awards from different national and international organizations. Six students were awarded doctoral degrees by various universities for work carried out in the Institute during the current year.

The Institute carried out a number of consultancy projects for the private and public sector worth Rs. 60 lakhs and the revenue generated during the year was Rs. 83 lakhs. Scientists of the Institute were able to win a number of projects from external funding agencies such as Ministry of Earth Sciences (MOES), Department of Biotechnology (DBT) and Science and Technology (DST) and MPEDA. The most significant project obtained was the multidisciplinary and multi-institutional project on exploitation of Yellowfins tuna resources from Lakshadweep Islands from NAIP to the tune of Rs. 6.3 crores.

INTRODUCTION

The marine fisheries sector in the country contributes about 45% of the total fish production and is one of the major contributors to foreign exchange earnings through seafood export. The phenomenal growth in marine fisheries during the last two decades was due to the introduction of innovative fishing practices, well-developed harvest and postharvest infrastructure and increased demand for marine fish products both in domestic and export markets. However, the annual fish production has almost remained static since 1997 when the production reached 2.97 million tonnes. The resource monitoring programme of the Institute show that there is a general decline in resource availability as evidenced by decline in catches and catch rate and incidence of large proportion of juveniles and young fish in the landings and decrease in average length at capture of many of the targeted species. Considerable volume of discards of non-target edible fishes by the multiday trawlers is a serious concern. Excessive trawling was also found to adversely affect the biodiversity and ecosystem productivity, which would negatively impact the fish production.

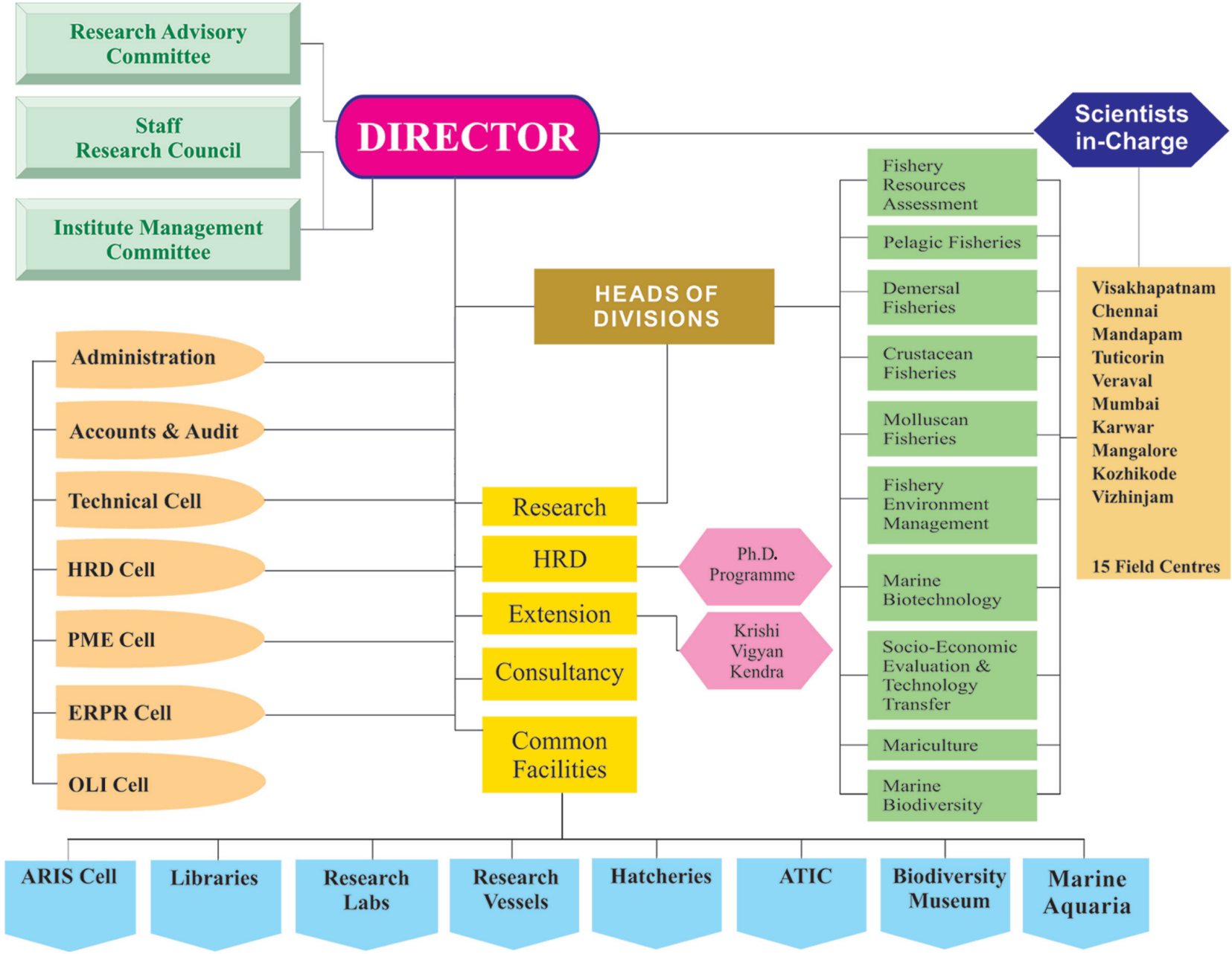
It has now been realised that one of the possibilities of increasing marine fish production is by exploiting oceanic resources. There are a couple of under-exploited resources such as oceanic tunas with an estimated potential of about 2.78 lakh tonnes. During the past couple of years, harvesting of oceanic tunas has increased substantially both by indigenous and mechanized fishing crafts. The potential of increasing fish production by exploitation of tuna resources from the two island ecosystems is also high, which needs to be given the highest priority. The road maps prepared by CMFRI for Andaman & Nicobar and Lakshadweep fisheries development will help in achieving the objectives. The potential for enhancement of fish production through large-scale ecofriendly open sea mariculture is also enormous. Management of the complex problems in marine fisheries is to be based on scientific principles and innovative research and the R & D efforts of CMFRI has been addressing these issues by undertaking need-based and solution-oriented research.

The Central Marine Fisheries Research Institute, which is celebrating the Diamond Jubilee of establishing the Institute in 1947 grew significantly in size and stature during the last 60 years by building up a fairly adequate research infrastructure and technically competent scientific man-power. The Institute's multidisciplinary approach to research in marine capture and culture fisheries has won the recognition as a premier Institute comparable to any well-established marine fisheries laboratory in the world.

To accomplish its mandate, the Institute monitors the marine fish landings from all along the country's coast from a regional perspective, conducts researches on characteristics of exploited marine fish stocks and impact of trawling on marine ecosystems, develops hatchery production technology and seafarming techniques, undertakes research in

The Mandate

- *To undertake basic, strategic and applied research in marine fisheries and mariculture.*
- *To monitor and assess the fisheries resources of the Exclusive Economic Zone (EEZ) and to understand the stock and its dynamics in relation to environment and human interventions.*
- *To develop and commercialize hatchery and production system technologies for finfish, shellfish and other commercial marine organisms in coastal and open seas.*
- *To build up database on marine biodiversity, carry out research on fragile marine ecosystems for their conservation and restoration.*
- *To undertake research on utilization of potentially beneficial marine organisms.*
- *To act as a repository of information on marine fishery resources with a systematic and analytical database for policy interventions and to carry out research on social and economic costs and benefits of marine fisheries.*
- *To conduct front line demonstrations and training to develop human resource for R & D in capture fisheries and mariculture.*
- *To create awareness and provide training and consultancy services.*


Research Advisory Committee
Staff Research Council
Institute Management Committee
DIRECTOR
Scientists in-Charge
HEADS OF DIVISIONS
Administration
Accounts & Audit
Technical Cell
HRD Cell
PME Cell
ERPR Cell
OLI Cell
Research
HRD
Extension
Consultancy
Common Facilities
Ph.D. Programme
Krishi Vigyan Kendra
Fishery Resources Assessment
Pelagic Fisheries
Demersal Fisheries
Crustacean Fisheries
Molluscan Fisheries
Fishery Environment Management
Marine Biotechnology
Socio-Economic Evaluation & Technology Transfer
Mariculture
Marine Biodiversity
Visakhapatnam
Chennai
Mandapam
Tuticorin
Veraval
Mumbai
Karwar
Mangalore
Kozhikode
Vizhinjam
15 Field Centres
ARIS Cell
Libraries
Research Labs
Research Vessels
Hatcheries
ATIC
Biodiversity Museum
Marine Aquaria

environmental characteristics of inshore sea and studies on marine biodiversity. Studies are also conducted on economics of fishery enterprises, socio-economic conditions of fisherfolk and co-management of fishery resources through participatory approach.

The organisational set-up

To effectively carry out these tasks, the Institute has established Regional Centres at Mandapam Camp, Veraval and Visakhapatnam, Research Centres at Mumbai, Karwar, Mangalore, Kozhikode, Vizhinjam, Tuticorin and Chennai and 15 Field Centres all along the coast. The entire activity is coordinated by the Headquarters at Cochin. The Institute has, over the years, built up laboratory, hatchery and farm facilities for carrying out research programmes and has been upgrading the same to meet the changing needs and additional requirements. The sanctioned staff strength of the Institute is: Scientific 189, Technical 330, Administrative 150, Auxiliary 6 and Supporting 262.

The multidisciplinary researches in capture and culture fisheries are conducted under ten Divisions: Fisheries Resources Assessment, Pelagic Fisheries, Demersal Fisheries, Crustacean Fisheries, Molluscan Fisheries, Fishery Environment Management, Marine Biotechnology, Socio-economic Evaluation and Technology Transfer, Mariculture and Marine Biodiversity. Interdivisional and interinstitutional programmes are carried out for greater utililisation of expertise and facilities. Besides, the Institute also takes up short-term research projects on important and priority areas through *ad-hoc* research projects funded by outside agencies in the country and abroad, and offers consultancy services to the clients from Government organisations as well as private industry.

The Institute provides facilities for Ph.D. programmes of the Central Institute of Fisheries Education, Mumbai, and several other Universities in the country. The teaching and guidance are provided by the scientists of the Institute.

The Krishi Vigyan Kendra imparts training in mariculture, agriculture, animal husbandry and other related subjects to fish farmers, agricultural farmers and farm women.

The Library and Documentation Section provides reference facilities to research staff and students of the Institute as well as to visiting scientists both within and outside the country. The implementation of Hindi as Official Language is carried out by the Official Language Implementation Committee (OLIC).

The results of research carried out in the Institute are published in various journals. Besides, the Institute brings out Bulletins, Special Publications, Quarterly Newsletter and the Marine Fisheries Information Service and publishes the Indian Journal of Fisheries.

Staff strength as on 31.03.2008

Category	Sanctioned	Filled	Vacant
RMP	1	-	1
Scientific	189*	105	84
Technical	330	293	37
Administrative	150	138	12
Supporting	262	217	45
Auxiliary	6	4	2
Total	938	757	181

* Revised to 173 and formal approval for the same is awaited from the Council.

Budget 2007 – 2008

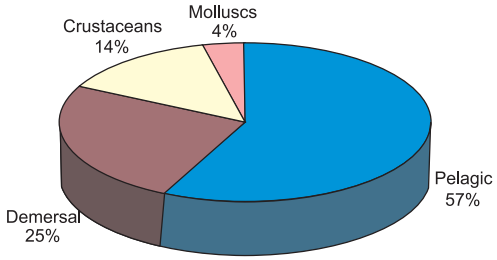
The budget allocation and expenditure details under Non-Plan and Plan for the financial year 2007-08

(Rs. in lakhs)

Sl. No	Sub Head	Revised estimate 2007-08	Expenditure for 2007-08
NON PLAN			
1	Establishment Charges	1675.00	1675.00
2	Other T.A.	0.43	0.43
3	Travelling Allowance	23.40	23.40
4	Other Charges	246.08	246.08
5	Works		
	a) Office Building	72.00	72.00
	b) Residential Building	30.00	30.00
	c) Minor Works	3.25	3.25
6	Other Items	0.00	0.00
	TOTAL	**2075.16**	**2075.16**
PLAN			
1	Establishment Charges	-	-
2	Travelling Allowance	25.00	25.00
3	Other Charges		
	a) Contingency	255.00	255.00
	b) Equipment	41.72	41.72
	c) Library	40.00	40.00
	d) Information Technology	15.00	15.00
4	Works		
	1. Works as per EFC		
	a) Special Repairs		
	b) Major works	5.00	5.00
	2. One time Catch-up-grant		
5.	a) Other items	2.00	2.00
	b) Human Resources Development	20.00	20.00
6.	N.E.H.	0.00	0.00
	TOTAL	**429.40**	**429.40**
	GRAND TOTAL	**2504.56**	**2504.56**

PROJECT CODE	**FRA/ASSESS/01**
PROJECT TITLE	**Development of knowledge-based information system for marine fisheries sustainability**
SCIENTISTS	**T.V. Sathianandan,** M. Srinath, J.Jayasankar, Somy Kuriakose and Wilson T. Mathew
CENTRES	Cochin and Chennai

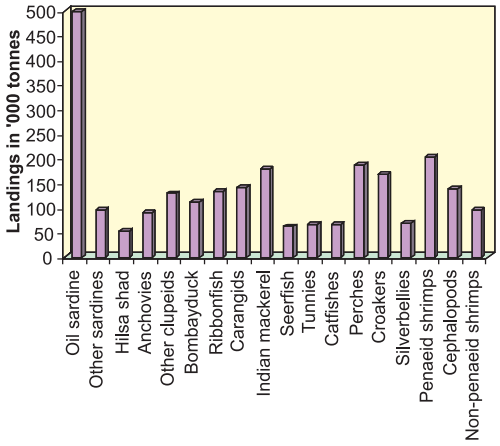
This project aims to estimate the marine fish landings and fishing effort in different regions of the country with resource-wise and gear-wise break up of the exploited resources and to update the database on marine fish landings in India. The time tested multistage stratified random sampling design was employed to collect and estimate the landings of the exploited marine fishery resources. It involved planning, execution and co-ordination of field work, processing of data and updating of the database and developing suitable formats for storage and retrieval of data.



Components of marine fish landings in India during 2007

As a part of the project, self managing sample selection software has been devised. It works with the MS Access database as the backend and keeps track of the sampling fractions allocated to various zones of all the maritime states. The work programmes issued periodically to field staff located at different centres will be generated in bilingual (Hindi and English) format by the new software. The software has been enriched with a module which keeps track of the expenditure incurred and also of the possible last minute changes taking place in the programmes.

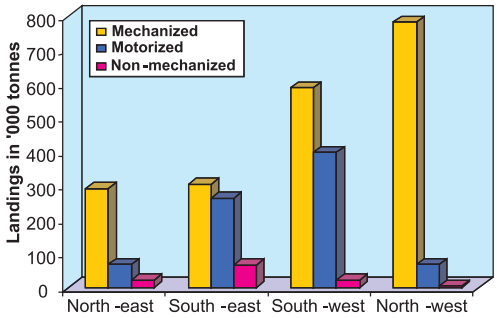
As part of sprucing up the marine fish landing database, the species and group codes allotted have been undergoing review. Towards harnessing maximum benefit out of such updated information, a software routine has been developed at DPU, Chennai Centre of CMFRI. The programme, CHKSPC, which is compatible with the existing data format can scan the entire set of files and check for the redundancy or inadmissibility of the four digit species code. From the output, the erroneous entries can be pinpointed and corrected.



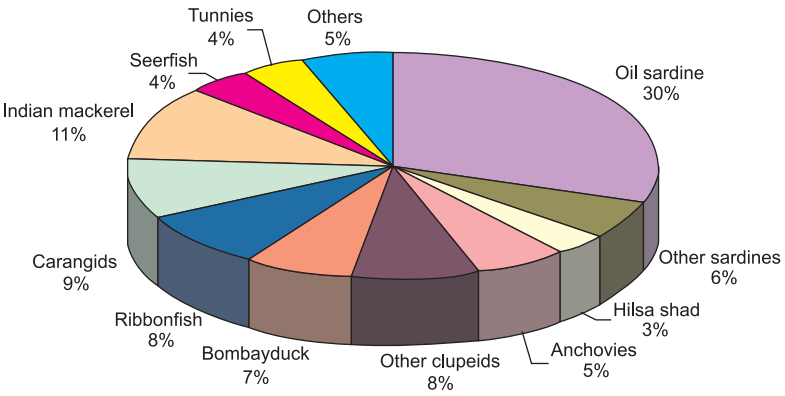
Landings of major fishery resources during 2007

Catch trends of major species/groups

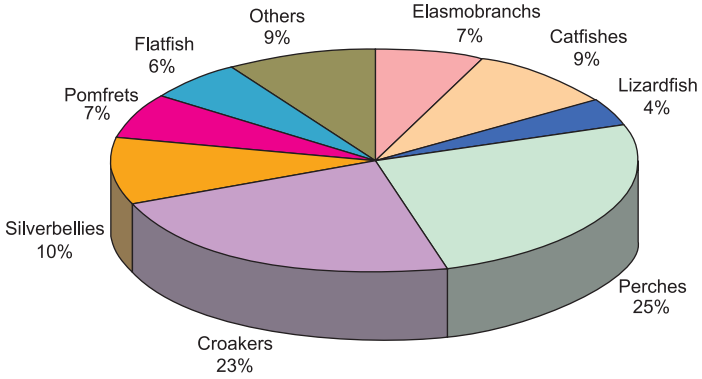
- Oil sardine landings were provisionally estimated as 4,97,264 t; 26% increase to that of 2006.
- Penaeid shrimp landings were 2,02,053 t (17.2% increase).
- Indian mackerel landings increased to 1,78,734 t (25.9% increase).
- Landings of croakers increased to 1,68,031 t (40.7% increase).
- Lesser sardine production was 94,827 t (6.5% increase).
- Silverbellies landings increased to 69,856 t from 64,626 t (8.1% increase).
- Other clupeids landing increased to 67,750 t from 41,786 t (62.1% increase).
- Non-penaeid shrimps landings decreased to 1,39,052 t from 1,70,787 t in 2006 (18.6% decrease).
- Ribbonfish landings decreased to 1,32,388 t from 2,35,045 t (43.7% decrease).



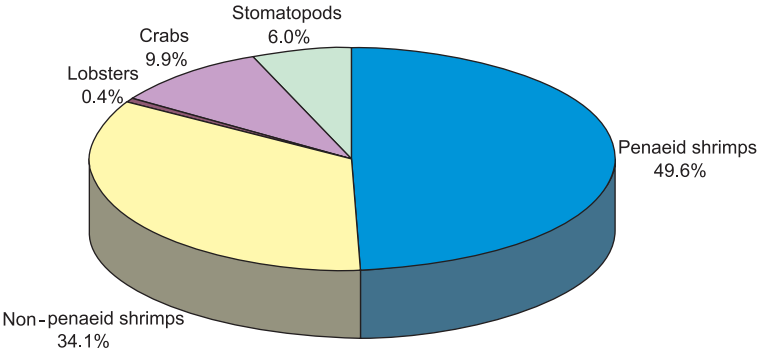
Sector-wise landings in different regions, 2007



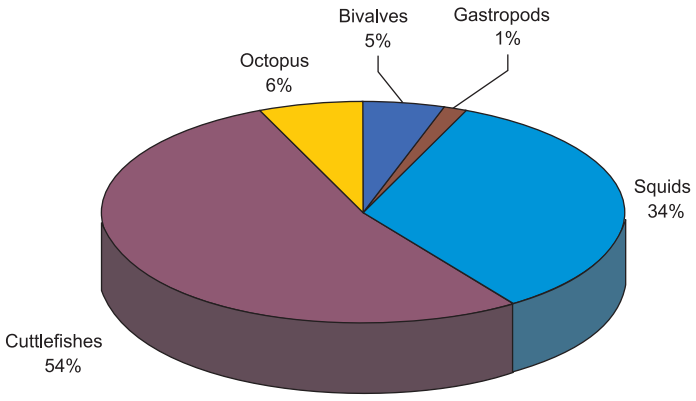
Components of pelagic finfish landings, 2007



Components of demersal finfish landings, 2007



Components of crustacean landings, 2007



Components of molluscs landings, 2007

Estimated Marine fish landings (t) during 2006 and 2007

Name of fish	Pelagic finfishes 2006	2007	Name of fish	Demersal finfishes 2006	2007
CLUPEOIDS			ELASMOBRANCHS		
Wolf herring	15519	15427	Sharks	29094	28159
Oil sardine	394598	497264	Skates	3018	2950
Other sardines	89041	94827	Rays	18566	16402
Hilsa shad	37372	52682	EELS	10265	13012
Other shads	10720	11498	CATFISHES	56540	66498
Coilia sp.	27607	29856	LIZARD FISHES	30311	28679
Setipinna sp.	3596	9450	PERCHES		
Stolephorus spp.	32704	50609	Rock cods	22168	24062
Thryssa sp.	32000	34638	Snappers	4451	4942
Other clupeids	41786	67750	Pigface breams	11009	10537
BOMBAYDUCK	118507	112721	Threadfin breams	111317	94221
HALF BEAKS &			Other perches	45595	53202
FULL BEAKS	4070	6097	GOATFISHES	16394	16443
FLYING FISHES	949	2198	THREADFINS	8316	10260
RIBBON FISHES	235045	132388	CROAKERS	119405	168031
CARANGIDS			SILVERBELLIES	64626	69856
Horse Mackerel	24901	28998	WHITEFISH	5092	6139
Scads	39409	43518	POMFRETS		
Leather-jackets	8547	11399	Black pomfret	15163	13907
Other carangids	49079	57652	Silver pomfret	25516	30809
MACKERELS			Chinese pomfret	3379	3017
Indian mackerel	141918	178734	FLATFISHES		
Other mackerels	1	1	Halibut	1328	873
SEER FISHES			Flounders	32	103
S. commerson	38398	41735	Soles	37747	40761
S. guttatus	10595	20115	MISCELLANEOUS	15841	21514
S. lineolatus	6	132	Total	655173	724377
Acanthocybium spp.	41	189	**Shellfish**		
TUNNIES			CRUSTACEANS		
E. affinis	30607	28071	Penaeid shrimps	172460	202053
Auxis spp.	16175	11461	Non-penaeid shrimps	170787	139052
K. pelamis	3330	2692	Lobsters	1551	1539
T. tonggol	6115	7155	Crabs	51067	40377
Other tunnies	7779	17363	Stomatopods	30551	24648
BILL FISHES	4397	5347	MOLLUSCS		
BARRACUDAS	17751	19933	Cephalopods		
MULLETS	7260	6359	Squids	51862	35036
UNICORN COD	639	576	Cuttlefishes	77436	56128
MISCELLANEOUS	35940	48938	Octopus	6743	3640
Total	**1486402**	**1647773**	Miscellaneous	6956	6713
			Total	**569413**	**509186**
			Grand total	**2710988**	**2881336**

Salient findings

- *The marine fish landings of India during the year 2007 has been estimated as 2.88 million tonnes, an increase of about 1.7 lakh tonnes (6.3%) against the estimate of the previous year.*
- *The pelagic finfishes constituted 57%, demersal fishes 25%, crustaceans 14% and molluscs 4% of the total landings.*
- *The sector-wise contributions during the year 2007 were: mechanized 68%, motorized 28% and the artisanal 4% .*

- Bombay duck landings decreased to 1,12,721 t from 1,18,507 t (4.9% decrease).
- Threadfin breams decreased to 94,221 t from 1,11,317 t (15.4% decrease).
- Cuttlefish landings decreased to 56,128 t from 77,436 t (26.7% decrease).

The estimate of region-wise production showed that the north-east region, comprising West Bengal and Orissa coasts contributed 13% to the total production. South-east region consisting of Andhra Pradesh, Tamil Nadu and Pondicherry coasts contributed 22%. On the west coast, the north-west region comprising Maharashtra and Gujarat coasts recorded 30% of the total, whereas, the south-west region comprising Kerala, Karnataka and Goa coasts contributed a maximum of 35%.

PROJECT CODE **FRA/ASSESS/02**

PROJECT TITLE **Decision support system for marine fisheries management**

SCIENTISTS **J.Jayasankar,** M. Srinath, T.V. Sathianandan, Somy Kuriakose and Wilson T. Mathew

CENTRES Chennai and Cochin

With the paradigm shift in the outlook towards model assisted stock assessment, inclusion of uncertainty at the parametric level has been hogging the limelight. With a view to incorporate the priori distribution and the related uncertainties, the study of biomass dynamic growth models has been taken up. For the catch and effort data, the Fox variant of the Schaefer's model has been focused upon. Routines have been written in R software and trial runs have been completed.

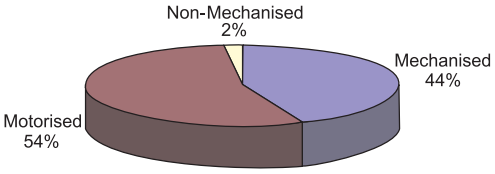
Non-informative priors have been targeted initially for their robustness and manipulative ease. For the four parameters of the Schaefer's model *viz.*, carrying capacity, intrinsic rate of growth, catchability coefficient and initial biomass, various priors like rectangular, log normal, gamma and normal priors were tested. It was decided that the parameters may be given gamma priors and the error may be allotted Gaussians prior.

Bayesian inference though in vogue for more than a quarter century now has built parallel centres of focus for all traditional methods of inference. Though there are a plethora of literature on the application of Bayesian methods in fisheries research, quite a few have been done on tropical waters. Towards formulating a comprehensive strategy, around 19 fisheries journals, specific manuscripts and thirteen general purpose publications in periodicals with specific reference to Bayesian analysis have been collected, collated and entered in the form of a database.

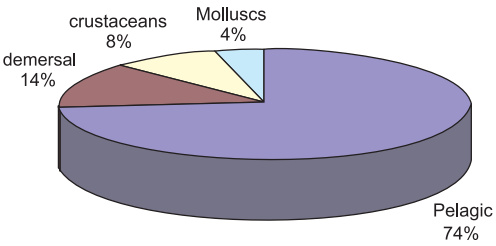
PROJECT CODE	**PEL/IDP/01**
PROJECT TITLE	**Management advisories for sustaining marine fisheries of Kerala and Lakshadweep**
SCIENTISTS	**N.G.K.Pillai,** A.A.Jayaprakash, U.Ganga, K.S. Mohamed, E.V.Radhakrishnan, E.Vivekanandan, S.Sivakami, Rekha Devi Chakraborty, N.G. Menon, C. Ramachandran, Somy Kuriakose, P.T. Sarada, P. Laxmilatha, P.N.R. Nair, M. Sivadas, P.P. Manojkumar, K.K. Philipose, Grace Mathew, S.Jasmine, M.K. Anil, T.S.Velayudhan, K.N.Saleela and K.P. Said Koya
CENTRES	Cochin, Calicut and Vizhinjam

Marine fish landings trend in Kerala during 2007

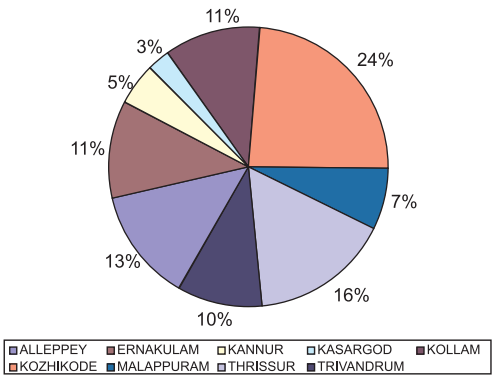
- The estimated marine fish landings of Kerala during 2007 was 6.19 lakh tonnes (t) and compared to 2006 showed an increase of 5%. Landings were also higher than the annual average (1988-2005) catch of 5.74 lakh t. Compared to previous year, the contribution of pelagic resources to the total landings increased. This was largely due to record catches of oil sardine and the substantial increase in mackerel landings.
- Among finfishes, pelagic resources accounted for 73% and demersals 14%. Crustacean resources accounted for 9% while cephalopods formed 4 %.
- Pelagic resources were mainly constituted by oil sardine (2,50,469 t), mackerel (68,062 t), carangids (39,875 t), tunas (25,009 t), ribbonfishes (11,431 t) and seerfishes (9750 t). Demersal resources were dominated by threadfin breams (27,943 t) and soles (19,146 t). Among crustaceans, penaeid shrimps were dominant (41,002 t). Cephalopods (mainly squids and cuttlefishes) contributed 23,391 t.
- The highest landings were recorded during the IV quarter (October – December); percentage contribution being 31.5%, followed by III quarter (28.5%), I quarter (23%) and II quarter (17%).
- The estimate of district-wise production showed that Kozhikode District contributed 24% followed by Thrissur (17%), Alappuzha (13%), Ernakulam and Kollam (11% each), Trivandrum (10%) and the rest (14%) from other coastal districts such as Malappuram, Kannur and Kasargod.
- The mechanized sector contributed 44%, motorized 54% and the rest 2% was by the artisanal sector. In the mechanized/motorized sector, among various gears, ring seines contributed 50%, trawls 26%, gill nets and hooks & line 18% and other gears (such as boat seine, purse seine) 4%.
- Ring seine (RS) landings (3.04 lakh t) were dominated by the pelagics such as oil sardine, mackerel and small carangids, mainly scads. CPUE in the in-board ring seines was 2.8 t (units) and 1.3t (AFH). CPUE in the out-board ring seines was 1.2 t (units) and 0.67 t (AFH).
- Trawl landings (1.57 lakh t) were dominated by penaeid shrimps, cephalopods, threadfin breams, ribbonfishes, lizardfishes, anchovies and elasmobranchs. Compared to last year, trawl landings declined by 35,000 t (18%) and its gearwise contribution decreased by 7%. CPUE in multiday trawl nets was 40 kg (AFH) and 1.02 t (units). CPUE in single day trawls was 33 kg (AFH) and 0.19 t (units).



Sectorwise marine fish landings of Kerala during 2007



Major components of marine fish landings in Kerala during 2007



Districtwise marine fish landings of Kerala during 2007

Outboard ringseine unit along the Malabar coast loading net for a fishing trip

- Gill nets and hooks and lines contributed 1,00,076 t dominated by pelagic sharks, oceanic tunas and billfishes.
- Among the important groups, oil sardine, mackerel, whitebaits, carangids, pomfrets, silverbellies, sciaenids, soles, rock cods and penaeid shrimps recorded an increase in the landings compared to 2006. Ribbonfish, cephalopod and elasmobranch landings showed significant decline during 2007 compared to previous year.
- Growth and mortality parameters and exploitation rates (E) were estimated for major pelagic (7 groups, 13 species), demersal (3 groups, 5 species), molluscan (2 groups, 3 species) and crustaceans (2 groups, 8 species) of commercial importance.
- The Long Term Potential Yield (LTPY) and Average Long Term Yield (ALTY) of marine fish landings of Kerala was estimated as 6.63 lakh t while the current yield was 6.19 lakh t, indicating little scope for increase in landings.

Potential yield estimates and landings of various resource groups during 2007

Resource	LTPY (t)	ALTY (t)	Yield 2007 (t)
Oil Sardine	264372	236182	250469
Mackerel	128411	106250	68062
Penaeid shrimps	71871	57894	41002
Seer fishes	10162	7862	9750
Cephalopods	43472	37658	23391
Tunas	32615	22671	25009
Silverbellies	6887	6176	6186
Elasmobranchs	6968	6136	2755
Lizard fishes	14126	13341	7741
Rock cods	9386	6822	3752
Snappers	2482	2066	1141
Threadfin breams	55078	45163	27943
Other perches	16488	13640	4716
Sciaenids	17720	15665	10363
Soles	27301	22802	19146
Total	**662890**	**624859**	**619255**

Mackerel landings

Pelagic finfish resources

- Oil sardine (*Sardinella longiceps*) landings estimated at 250,469 t showed an increase of 11% over the last year (226,268 t). Ring seine was the major gear employed and contributed 83% of the landings followed by gill nets (12%), boat seines (3%) and the rest by artisanal sector. Size group 92-172 mm dominated the landings of Malabar upwelling region. Spawning stock biomass formed 37% of the total standing stock. At Cochin, the size range of oil sardine in ring seine was 90 -170 mm with a mean size 145 mm and mode 130 mm. 42% (in numbers) of landings was less than L_m (140 mm).Exploitation was at MSY level.
- Besides oil sardine, *Sardinella fimbriata* was observed as a seasonal catch during August to December period in the ring seine landings at Cochin. Seasonal landings of *S.gibbosa* was reported from Calicut.

Sorting of fish landings at Neendakara Fisheries Harbour

- Mackerel landings were estimated at 68,062 t and showed an increase of 51% compared to 2006. Ring seines contributed (74%) followed by drift gill nets (20%), hooks and lines (2%) and trawls (3%).
- Along the Malabar coast, 92% of mackerel landings were contributed by ring seines which was operated from March –December, but peak landings were during August to December. The size ranged from 115 to 290 mm with mode at 230 and 195 mm and mean size of 191 mm. The spawning stock biomass was 59% of total standing stock and exploitation was optimum.
- Along south Kerala coast length range of mackerel was 180 –285 mm and the length at first capture (Lc) was 134 mm. Exploitation rate (E) was 0.6 and spawning stock constituted 66% of the standing stock biomass.
- Along the Malabar coast, 99% of the ribbonfish landings was by trawl. The catch rate (in actual fishing hours, AFH) was 12.8 kg in multiday trawls and 0.3 kg in single day shrimp trawls. Size range of *T.lepturus* was 40 -80 cm with mean length (ML) at 62cm. L_m was 46cm.The spawning season of ribbonfish off the Malabar coast was during August to October.
- The size range of Yellowfin tuna was 40-186 cm but fishery groups that dominated were 80 -110 cm. Only 6% of the landings (in numbers) were less than the L_m of 70 cm compared to 40 % in 2006. Skipjack tuna of size range 38 –86 cm were landed with the size group 48 –62 cm fork length (FL) dominated. Compared to the previous year, exploitation rate (E) of skipjack was constant at 0.7 while for Yellowfin it was optimum (0.5).
- Size range of *E. affinis* was 32 -68 cm and only 10% of the landings (in numbers) were less than L_m. Size range of *A. thazard* was 32-68 cm and only 10% of the landings (in numbers) were less than L_m. Exploitation rate (E) for these coastal tunas (*A. thazard* and *E. affinis*) was 0.6.

Fishery related parameters of some important pelagics

Species	Length range (mm)	Mean size (mm)	Fishery dominant size group (mm)	Exploitation rate (E)	% numbers landed $<L_m$
S.longiceps	90-200	145	140-180	0.5	42
R.kanagurta	110-280	215 (trawl) 192 (RS)	180 -220	0.5	28
S.commersonii	50-130	105	90-110	0.7	7
S.macrops	55-80	67	60-70	0.8	5
E.devisi	60-90	65	65-80	0.7	5
E.affinis	320-680*	460	380 -520	0.6	10
A.thazard	200-440*	360	300-400	0.6	26
K.pelamis	380-860*	520	480-620	0.7	0
T.albacares	400-1860*	820	500-960	0.4	6
D.russelli	140-240	215	175 -220	0.6	10
M.cordyla	190 -385	277	240 -360	0.5	15
T.lepturus	510-910	620	460-800	0.6	0
*S.commerson**	320-980	590	480-660	0.6	85

*Fork length (FL)

Sole fish landings at Chombala Fisheries Harbour

Demersal finfish resources

- Elasmobranch landings of Kerala was estimated at 2755 t and showed marginal decrease compared to 2006. Sharks, skates and rays formed 60, 8 and 32%, respectively of the total elasmobranch landings.
- Species of sharks recorded in the landings included longtail shark *Alopias supercilliosus, Carcharhinus limbatus, Centrophorus uyato,C.mollucensis* and *Sphyrna lewini*. The devil ray *Mobula japanica* contributed most of the ray landings followed by *Himantura bleekeri*. The guitar fish *Rhinobatus* sp. were landed in small quantities by gill net.
- Stock assessment studies made on *C. limbatus* showed that this resource is under heavy fishing pressure. The estimated spawning stock biomass of *C. limbatus* was 30% of the annual stock.
- Stock assessment of the Malabar sole *C. macrostomus* was done for the Kerala coast. Growth and mortality parameters were estimated as L"= 18.3 cm; K = 0.92 per year; exploitation rate (E) was 0.68 which was lower than the estimated E_{max} of 0.75. L_c was 9.7 cm.
- Lizardfish landings estimated at 7741 t showed a slight increase compared to 2006. Multiday trawl net was the most important gear employed contributing nearly 90% of the landings.
- At Cochin Fisheries Harbour, *Saurida tumbil* was the major species (83%) followed by *S.undosquamis* (40%) and *Trachinocephalus myops* (2%). Spawning stock biomass of *S.tumbil* and *S.undosquamis* was 60% and 57% of the standing stock, respectively.

Crustacean resources

- Crustacean landings composing of penaeid and non-penaeid shrimps, crabs and stomatopods were estimated at 52039 t and showed a decline of 26% compared to 2006. Penaeid and non–penaeid shrimps comprised 68% and 15% of the crustacean landings, respectively, followed by stomatopods (12%) and crabs (5%).
- Along the Malabar coast, 64% of the shrimps were landed by mechanised trawlers followed by ring net (26%), indigenous trawl net (9%) and by gill net (1%). *Metapenaeus dobsoni* dominated (35%) followed by *Parapeaneopsis stylifera* (27%), *Fenneropenaeus indicus* (16%), *M.affinis* (9%) *Trachypenaeus curvirostris* (7%) and *M.monoceros* (5%). Prediction analysis using Thomson and Bell yield analysis indicated that the MEY levels for most of the shrimp species has been attained and further fishing effort has to be decreased.

Penaeid shrimp catch at Chombala Fisheries Harbour

- Peak landings of deep sea lobster (*Puerulus sewelli*) occurred during February and May. Length range of 61-200 mm TL (mean 120 mm) were observed for females of *Puerulus sewelli*. Peak breeding was during January. 48% of the landings were below the length at first maturity, highlighting the need for awareness on conservation of the lobster resource among fishers and traders.
- Crab landings of Kerala estimated at 3643 t increased by 18% compared to previous year.
- At Calicut, *Portunus sanguinolentus* dominated (46%) followed by *Charybdis feriatus* (44%) and *P.pelagicus* (11%). At Cochin *P.*

sanguinolentus dominated (57%) followed by *P.pelagicus* (31%), *C.feriatus* (12%) and *C.lucifera* (3%). At Vizhinjam, fishery was entirely formed by *P.sanguinolentus*. Exploitation rate was optimum.

Cuttlefish landings

Molluscan resources

- Cephalopod catch in Kerala during 2007 was estimated at 23,392 t and showed a decline of 25% compared to previous year. Cuttlefishes contributed 59% followed by squids (30%) and octopus (11%). *Sepia pharaonis, S. aculeata* and *Sepiella inermis* (cuttlefish), *Loligo duvauceli, Doryteuthis sibogae* (squids), *Octopus membranaceous, O. dolfusi, Cystopus indicus* (Octopus) were observed in the fishery.
- The total bivalve production in the Malabar region (Kozhikode, Kannur, Mahe excluding Kasargod), was estimated at 9695 t and compared to previous year showed a decline of 38%. The green mussel *Perna viridis*, formed 77 % of the total bivalve production from this region. The clams *Meretrix casta* and *Villorita cyprinoides* contributed 6%, and rest was by the edible oyster, *Crassosstrea madrasensis*. The peak production of *Perna viridis* was during January to March and October to December.
- Backwater clams such as *Meretrix casta*, *Villorita cyprinoide*s and *Paphia malabarica* were recorded from Vembanad and Ashtamudi lakes as well as the marine clam *Sunnetta scripta* from Vypin Island.
- A self-imposed ban on fishing for *Paphia malabarica* in the Ashtamudi lake during the period December to February was continued during 2007. Length range of this export variety clam was 26.5 mm to 36.5 mm in April and September, respectively.

Socio-economic and behavioural studies

- Studies were conducted on the "unionization" behaviour of fishermen and other stakeholders in the marine fisheries sector of Kerala. Although migrant fish workers mainly from Colachel region, contribute significantly to the workforce in the marine fisheries sector of Kerala they largely remain unorganized. However, other sectors such as boat owners, auctioner, head load workers, water suppliers, ice crushers and seafood dealers are largely organized.

Marine fisheries of Lakshadweep

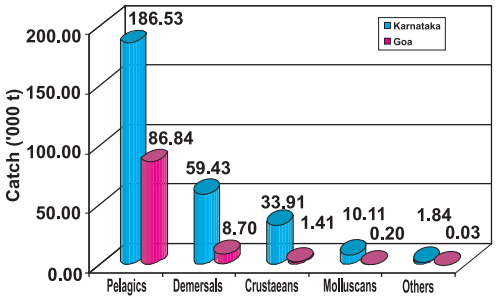
- The total fish catch from Minicoy, Androth and Agatti was estimated at 3144 t. Catch rate in the pole and line fishery was 4.2 kg/hour followed by hand line (2.55 kg/hr), troll (2.28 kg/hr), encircling gill nets (2.08 kg/hr) and drift gill nets (1.28 kg/hr).
- Tunas formed 96% of the total fish landings. Minicoy accounted for 72% of the tuna landings followed by Agatti (25%) and Androth (3%).
- Compared to 2006, poor catch rates were observed in the pole and line fishery for tunas at Minicoy and Agatti, being 501.4 kg (550 kg in 2006) and 316 kg (494 kg in 2006), respectively.
- At Minicoy, in pole and line, skipjack (*Katsuwonus pelamis*) dominated (90%) followed by Yellow fin (*Thunnus albacares*) (8%) and frigate tuna *Auxis thazard* (2%). In troll, Seerfish *Acanthocybium solandri* (75%), sailfish *Istiophorus platypterus* (8%), Yellowfin (7%)

Flying fish and half beaks caught with encircling gill net at Androth Island

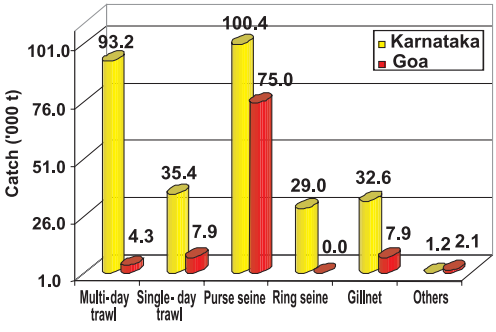
and skipjack (4%) occurred. Handline catches were constituted solely by Yellowfin.

- At Agatti, in pole and line catches, skipjack dominated (97%) followed by Little tunny *Euthynnus affinis* (2%), Frigate tuna (0.6%) and Yellow fin (0.4%). In troll, yellowfin (45%), Seerfish *A. solandri* (16%), Skipjack (12%) and little tunny (5%) occurred. Handline catches were constituted by *Lethrinus* spp., *Lutjanus* spp., carangids and yellowfin.

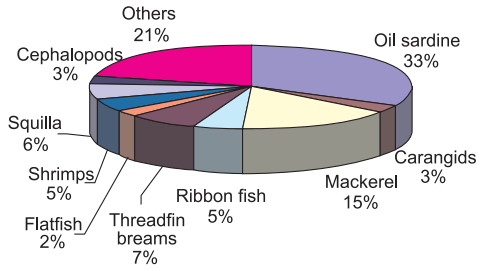
PROJECT CODE **PEL/IDP/02**
PROJECT TITLE **Management advisories for sustaining marine fisheries of Karnataka and Goa**
SCIENTISTS **C. Muthiah**, N. Ramachandran, S. G. Raje, A. P. Dineshbabu, Geetha Sasikumar, P. S. Swathilekshmi, M. Srinath and Saly N. Thomas (CIFT)
CENTRES Mangalore and Karwar



Catch contribution by different groups in Karnataka and Goa.



Catch contribution by different gears in Karnataka and Goa



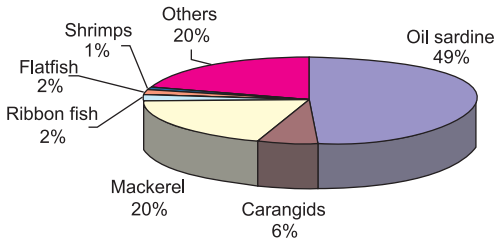
Catch composition in Karnataka

- In Karnataka, during 2007, the estimated monthly marine fish landings of the State varied between 2,068 t (June) and 46,555 t (October).
- The annual catch was 2,91,813 t showing 21.1% increase as compared to that recorded in 2006 (2,40,888 t).
- Major gears contributing to the catch are multiday trawl (MDT), (31.9%, C/hr: 31.8 kg), singleday trawl (SDT), (12.1%, C/hr: 38.3 kg), ringseine (9.9%, C/E: 1960.3 kg), gillnet (11.2%), purseseine (3.4%, C/E: 1842.9 kg) and 'other gears' (0.4%).
- Pelagics dominated the landings with 63.9%, followed by demersal finfish (20.4%), crustaceans (11.6%) and molluscs (3.5%).
- In Goa, the estimated marine fish landings was 97,160 t. showing 7.9% decrease as compared to 1,05,539 t recorded in 2006.
- Major gears contributing to the catch are purseseine (77.2%, C/E: 2,985 kg), singleday trawl (SDT), (8.1%, C/hr 39.1 kg), multiday trawl (MDT), (4.4%, C/hr: 20.5 kg), gillnet (8.1%) and 'other gears' (2.2%).
- Pelagics dominated the landings with 89.4%, followed by demersal finfish (9.0%), crustaceans (1.5%) and molluscs (0.2%).

Catch trends of major groups are as follows:

- Seerfish landing showed an increasing trend (5%) in Karnataka, whereas, a decreasing trend (53%) in Goa compared to 2006 was observed.
- Ribbonfish landing in 2007 showed a decreasing trend in both Karnataka (47%) and Goa (30%).
- Sardine landing during the year showed an increasing trend (52%) in Karnataka whereas, a decreasing trend (8%) in Goa.
- Mackerel landing showed an increasing trend in Karnataka (116%) and in Goa 19%.
- Threadfin breams showed a decreasing trend in Karnataka (4%) and in Goa (50%).
- Whitefish landing during the year showed 82% increase in Karnataka and 62% decrease in Goa.

- Elasmobranchs landing showed an increasing trend (7%) in Karnataka whereas, a decreasing trend (71%) in Goa.
- Shrimp landing showed 25% increase in Karnataka and 58% decrease in Goa.
- Crab landing in 2007 showed 51% increase in Karnataka and 20% decrease in Goa.
- Cephalopod landing during the year showed 38% decrease in Karnataka and 33% decrease in Goa.



Catch composition in Goa

Status of exploitation ratio *(E)* of 25 major species in 2007

Below optimum level (2)	*A. thazard* (0.46), *O. membranus* (0.5)
Optimum level(6)	*N. japonicus* (0.58), *M. dobsoni* (0.52), *P. stylifera* (0.52), *M. monoceros* (0.54), *M. casta* (0.58), *P. malabarica* (0.56)
Above optimum level (17)	*S. commerson* (0.73), *E. affinis* (0.65), *T. lepturus* (0.73), *S. longiceps* (0.70), *R. kanagurta* (0.73), *S. waitei* (0.65), *E. devisi* (0.63), *D. russelli* (0.73), *M. cordyla* (0.66), *N. mesoprion* (0.64), *L. lactarius* (0.70), *C. macrostomus* (0.80), *S. choprai* (0.62), *P.pelagicus* (0.67), *P. sanguinolentus* (0.71), *L. duvaucelli* (0.73), *S. pharaonis* (0.74).

Landing of Bull's eye in Karnataka

Salient features of the fishery:

- Heavy landing of bull's eye, *Priacanthus hamrur* was observed during the year in 2007 (7946 t) in Mangalore Fisheries Harbour. Major landing was during October-December. The catch was taken by processing plants for "*surumi*" preparation which substituted the catch reduction of threadfin breams.
- The mean size of threadfin breams showed considerable reduction this year also indicating the capture of smaller sized fishes in the fishery.
- Pufferfishes *Lagocephalus inermis*, has gained attention as a new fishery resource along the coast. An estimated total of 435 t was landed in 2007. The fishes are caught by multiday trawlers going for fishing for 8-10 days at a depth of 80 – 100 m. This fish is beheaded viscera removed and the skin peeled off. It is cured in salt, dried, packed and transported.

Major marine fish catch (t), and percentage composition in Karnataka and Goa

Species/groups	Karnataka catch	% in all-fish	Goa catch	% in all-fish	Karnataka+ Goa catch
Oil sardine	94849	32.5	47712	49.1	142561
Lesser sardine	5330	1.8	2562	2.6	7892
Whitebaits	2884	1	8	0	2892
Carangids	7887	2.7	5807	6	13694
Mackerel	45222	15.5	19153	19.7	64375
Ribbon fish	15120	5.2	1996	2.1	17116
Seer fish	4000	1.4	1383	1.4	5383

Landing of pufferfishes in Karnataka

Catch in Panjim fishing harbour

Tunas & billfishes	842	0.3	3493	3.6	4335
Threadfin breams	20468	7	369	0.4	20837
Whitefish	2681	0.9	155	0.2	2836
Flatfish	6600	2.3	1467	1.5	8067
Silverbellies	3851	1.3	2164	2.2	6015
Pomfrets	404	0.1	106	0.1	510
Elasmobranchs	740	0.3	676	0.7	1416
Shrimps	13895	4.8	899	0.9	14794
Crabs	2511	0.9	347	0.4	2858
Stomato podes	17493	6	159	0.2	17652
Cephalopods	10072	3.5	200	0.2	10272
Others	36964	12.7	8504	8.8	45468
Total	291813		97160		388973

PROJECT CODE CF/IDP/01

PROJECT TITLE **Management advisories for sustaining marine fisheries of Maharashtra**

SCIENTISTS **V.D. Deshmukh,** M.Z. Khan, S.G. Raje, Paramita Banerjee Sawant, Somy Kuriakose, and V.P. Vipinkumar

CENTRES Mumbai and Kochi.

The landing of 27,440 t of oil sardine was the most unprecedented, especially along the northern coast of the state. It is noteworthy that the oil sardines brought from 'dol' nets operated at Vasai appeared emaciated with large head and lean body. When compared to 2006, oil sardine and mackerel showed 5 fold and 2.4 fold increase respectively.

- Estimated marine fish landing in Maharashtra was 3.19 lakh t during 2007, valued at Rs 1,262 crores. The catch recorded marginal increase of 4.6% over last year. Shrimp trawl was the major gear that contributed 1.57 lakh t (49.1%) followed by *dolnets* with 1.1 lakh t (33.1%), gillnet 38,772 t (12.1%), purseseine 12,855 t (4.0%), hooks & lines 4,753 t (1.5%) and others 705 t (0.8%).
- Penaeid shrimps (13.7%), non-penaeid shrimps (12.3%), croakers (9.6%), sardines (9.4%) and Bombay duck (8.8%) formed the major components of the landings.
- The catch of tuna and bill fishes, catfishes, Bombayduck, croakers, and penaeid shrimps showed 42, 19.5, 11.4, 9.4 and 8.5% increase, respectively over 2006. However, catch of ribbonfish (-42.4%), threadfins (-27.6%), lizardfish (-21.4%), flatfishes (-18.9%), non-penaeid shrimps (-16.9%) and eels (-9%) showed significant decline over last year. Investigations on 37 species comprising of 20 resources were carried out in the project.
- During the year, fishing by all mechanized fishing boats was banned during 10th June-15th August all over the state. However, small scale fishing continued in creeks and inshore waters.

Trawl fishery

- Trawling effort (5.65 million h) declined by 11.6% while the catch decreased by 10% registering 2% decline in the catch rate in the state. Reduction in trawling effort was mainly due to lower catch rates and consequent layoff of many trawlers.

- The trawl fishery was investigated from New Ferry wharf (NFW), Sassoon docks and Versova landing centres in Mumbai, where two-third of the state's landings is brought. At New Ferry wharf and Sassoon dock, multi-day trawlers with fishing trips ranging from 6-14 days were operated while at Versova landing centre multi-day (4-6 day trips), single day and hand trawlers were operated.

'*Dol*' net fishery

- *Dol* nets landed 1.1 lakh t of fish at the catch rate of 40.9 kg/hr. When compared to 2006, although number of boat trips was declined by 27%, the catch was improved by 15% and the catch rate by 37%.

Gillnet fishery

- The gill nets of varying mesh sizes from 20-180 mm mesh together landed 38,772 t of fish at the catch rate of 251 kg/trip. When compared to 2006, the number of boat trips were increased by 7%, the catch improved by 53% and the catch rate increased by 43%.

Purseseine fishery

- Purse-seiners based mainly at Ratnagiri and Mumbai landed 12,855 t of fish by the operation of 57,789 trips at the catch rate of 222.4 kg/trip. When compared to 2006, the catch improved by 28% while catch rate declined by 13%.

Total estimated catch, catch rate and gear-wise percentage of catch

Gear	Catch (t)	%	Catch rate
Trawl	157000	49.1	27.8 kg/hr
Dolnet	110000	33.1	40.9 kg/ hr
Gillnet	38772	12.1	251.0 kg/trip
Purse seine	12855	4.0	222.4 kg/trip
Hooks & lines	4753	1.5	

Resource-wise investigations

Total catch, gear-wise catch and population parameters of *Harpadon nehereus and Coilia dussumieri*

Species	Total Catch (t)	Dolnet catch (t) (catch rate)	Trawl catch (t) (catch rate)	Spawning stock biomass (t)	Standing stock (t)	No. of recruits (million)
Harpadon nehereus	28110	21082.5 105Kg/unit	6774.5 (1.5 Kg/hr)	7645	21031	2469
Coilia dussumieri	9701	3831.9 (28.5 Kg/unit)	4588.6 (0.7 Kg/hr)	884	5374	5414

- ***Bombay duck*:** Estimated catch of 28,110 t was landed showing 11.4% improvement over 2006. The *dol* nets contributed 75% while trawlers 24.1% to the total catch. In *dol* nets the catch increased by 63.4% while the catch rate increased by 9.4 %. The catch rate of Bombay-duck in trawlers landed at NFW was 1.5 kg/hour while in *dol* nets at Arnala, the catch rate was 105 kg/unit. The improvement in the catch and decline in trawls is a good sign for the recovery of the stock. The sex ratio was 1:1.98 and gravid females were recorded during May. Spawning stock biomass was 7,645 t, standing stock 21,031 t and the number of recruits was 2469 million.

- ***Penaeid shrimps:*** Estimated catch of penaeid shrimps was 43,695 t of which 89% was contributed by the trawlers and 10% by the *dol* nets. The catch rate in trawlers at NFW and Versova was 6.2 kg/hr and 6.8 kg/hr, respectively. When compared to 2006, the catch of *Metapenaeopsis stridulans* (-67%), *S. crassicornis* (-29%), *P. hardwickii* (-7%) and *M. affinis* (-41%) recorded notable decline while *M. affinis* (+58%), *M. monoceros* (+65%), *P. stylifera* (+18%), *M. brevicornis* (+14%), *M. kutchensis* (+4%), *P. sculptilis* (+5%) and other penaeids (+16%) recorded increase.

- ***Non-penaeid shrimps:*** Estimated catch of 39,291 t of non-penaeid shrimps was landed that contributed 12.3%. *Dol* net was the major

gear (88%) followed by shrimp trawlers (11%) wherein the non-penaeid shrimps contributed 32.7% in the former and 3% in the latter. *Dol* net fishery at Arnala, New Ferry wharf and Sassoon dock showed three species, *Acetes indicus*, *N. tenuipes* and *E. ensirostris* with their respective percentage 74, 22 and 4, respectively. Only 2 species of non-penaeid shrimps were landed by the trawlers viz. *N. tenuipes* and *E. ensirostris* at both NFW and Versova in Mumbai.

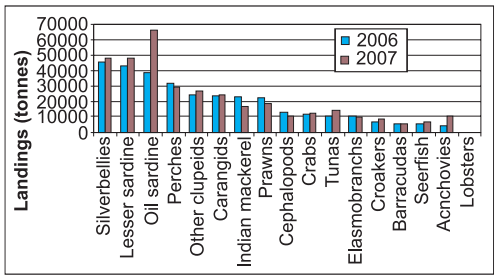
- ***Lobsters*:** The lobsters formed 0.21% of the total fish catch landed in the state. The catch and the catch rate in trawlers were 220 t and 0.05 kg/hr. In gill nets, bumper catch was landed in September (273 t) and December (62 t). In trawl, there was 47% decline and in gill nets 77% increase in the catch was observed. Since the catch in gill nets consisted of large number of small sized lobsters, the recruitment during the year appears to be good. During the year 7.3 t of sand lobster *Thenus orientalis* was landed by the trawlers in addition to *Panulirus polyphagus* (213t) at NFW in Mumbai. Maximum percentage of berried females (52%) was in September.
- ***Crabs*:** The crab landings in the state were 849 t of which 705 t (83%) was from shrimp trawlers. The catch recorded 38% decline when compared to 2006. The composition of crabs in the catch was *C. feriatus* (66.1%), *P. sanguinolentus* (16.9%), *P. pelagicus* (7.5%) and other crabs (9.5%). The berried females of *C. feriatus* were maximum in August (77%) and March (75%).
- ***Elasmobranchs:*** The catch landed by trawl, gill and *dol* net was 4219 t, 5395 t and 383 t, respectively. The catch recorded 20% decline in trawl and 30% and 33% increase in gill nets and dol nets, respectively. The percentage composition in trawlers was sharks 54%, rays 29% and skates 17%. Among sharks, *S. laticaudus* (77%), in the ray *Himantura alcockii* (44%) and in the skate *R. djeddensis* (90%) were the dominant species.
- ***Lizard fishes:*** Estimated catch of lizard fish in Maharashtra was 2,080 t almost entirely from trawlers. *S. tumbil* and *S. undosquamis* contributed 98% and 2%, respectively to the lizard fish catch. The incidence of juveniles (<280mm) in the catch of the former was as high as 64%. Females were in spent condition in October.
- ***Pomfrets*:** The estimated catch was 6,551 t, which recorded marginal decline. Pomfrets contributed 0.8% in trawl, 6.3% in gillnet and 2.6% in *dol* nets and the silver pomfret *P. argenteus* formed 61, 53 and 93%, respectively. The mean size of silver pomfret was 179.3, 200.2 and 171.5 mm in *dol*, gill net and trawl; the percentage of juveniles (< 270 mm size) landed by these gears was 97, 97 and 99.6%, respectively. Females were dominant (70%) and gravid females were noticed in October. Most of the stomachs (90%) were empty.
- ***Polynemids*:** The catch of polynemids in trawl was 1,224 t, which was decreased by 41% when compared to the previous year. *P. heptadactylus* (84%), *P. indicus* (14%) and *E. tetradactylus* (1%) were the major species. About 70% of the catch of *P. heptadactylus* was constituted by the juveniles (< 133mm). The size of *P. heptadactylus* in trawl was 70-260 mm and of *P. indicus* in gill nets, 81-119 cm.

Highly valuable airbladder of sciaenids

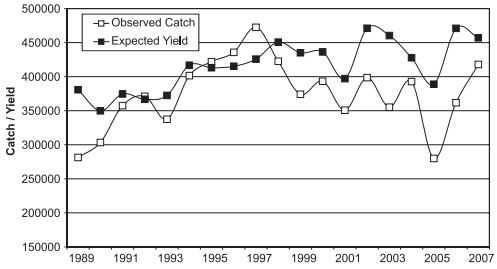
- ***Sciaenids*:** When compared to last year, the catch of sciaenids improved by 9.4%, but in trawls the catch declined by 16.5%. The species composition showed dominance of *J. vogleri* (26%) and the 'Koth' *O. biauritus* (25%). Percentage of juveniles of *J. vogleri* (size <155 mm) was 31% against 14% recorded in 2006 and the mean size has plummeted from 194 to 170 mm. In the case of *O. biauritus*, the length range was 80-1600 mm with mean size 400 mm; the entire catch (size<1185 mm) consisted of juveniles (99.7%). Biological studies were carried out on 63 specimens (length range: 600-1520 mm) out of which 8 were in mature state. In the case of 'Ghol' the length range was 110-1300 mm (mean size 337 mm) and the percentage of juveniles in the catch was 87%.
- ***Groupers*:** *E. diacanthus* dominated the catch (87%) followed by *E. tauvina* (9%) and *E. latifasciatus* (3%). Quantitative food analysis showed *N. mesoprion*, crabs and the shrimp *Solenocera* sp. as the most important diet items. In case of *E. diacanthus*, male specimens (350>mm) were noticed for the first time (5.7%); hermaphrodites were (3%) and females (92.3%). Immature females (67%) dominated the catch.
- ***Catfishes*:** The catch of catfishes landed in the state was 10,105 t showing an increase of 29% when compared to 2006. *O. militaries* dominated the catch (39%) followed by *A. dussumieri* (26%), *A. tenuispinis* (17%), *A. caelatus* 13% and *A. thalassinus* (3%). Size of *O. militaris* and *A. tenuispinis* ranged between 120-519 mm 180-519 mm and the mean size of the former has declined from 286 mm to 258 mm.
- ***Threadfin breams*:** The catch was 12,346 t which declined by 25% when compared to 2006. *N. japonicus* (52%) dominated the catch followed by *N. mesoprion* (45%) and *N. delogae* (3%). Only 57% of *N. mesoprion* catch consisted of juveniles (mean size 135 mm); most of them were in maturing stage. In case of *N. japonicus*, 64% were juveniles (mean size 134 mm). The sex ratio of the species showed dominance of males (1:0.5) with maximum number of females in mature condition.
- ***Eels*:** The catch of eels was 3173 t which contributed 1% to the total landings. The catch recorded 9% decline when compared to 2006. The catch was mainly landed by the trawlers (72%); gill nets and 'dol' nets landed 16% and 12%, respectively. Size of *Congresox talabanoides* ranged from 50-180 cm with mode at 140 cm.
- ***Cephalopods*:** The catch of cephalopods 13,876 t declined by 32% when compared to 2006. The catch was constituted by squids *Loligo duvaucelli* (46.1%) followed by *Sepia pharonis* (20.9%), *S. aculeata* (14.8%), *S. inermis* (14%) and *Cistopus indicus* (4.2%). In case of *S. pharonis*, the size ranged between 90-359 mm in mantle length with mean size of 226.3 mm. The sex ratio was 1:0.5 and the mature individuals (62%) dominated the catch. The food mainly consisted of shrimps followed by fish and crab. In case of *C. indicus*, the size ranged between 50-159 mm in mantle length with modes at 80-89 mm and mean size of 80.2 mm. Sex ratio was 1:0.25 and the immature individuals (60%) dominated the catch while the mature individuals contributed 40%. The stomach was always empty.

Catch of eel, *Congresox talabanoides*

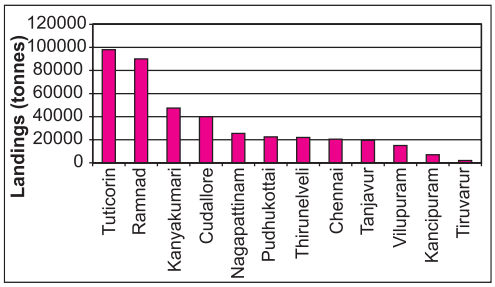
PROJECT CODE	**DEM/IDP/01**
PROJECT TITLE	**Management advisories for sustaining marine fisheries of Tamil Nadu and Puducherry**
SCIENTISTS	**P.U. Zacharia,** E.M. Abdussamad, T.S. Velayudhan, V. Kripa, A. Raju, M. Rajamani, V. Venkatesan, H. Mohamed Kasim, Joe Kizhakudan, Shoba Joe Kizhakudan, S. Lakshmi Pillai, T.V. Sathianandan and Wilson T. Mathew
CENTRES	Tuticorin, Mandapam and Chennai



Landings of major marine fish groups along Tamil Nadu during 2006 and 2007



Surplus production model for Tamil Nadu



Districtwise marine fish landings at Tamil Nadu during 2007

- The estimated marine fish landings of Tamil Nadu was 4,12,066 t during 2007. The catch increased by 14.7% from that of 2006. Mechanized trawlers contributed 46% to the catch. The maximum landings were at Tuticorin and Ramanathapuram districts.
- Pelagics formed 53.9%, demersals 29.6%, crustaceans 8% and molluscs 2.7% of the total landings. The landings of pelagics increased by 21.6% while molluscs and crustaceans recorded fall by 18.8% and 6.6%, respectively. Among the pelagics, sardines dominated the landings (1,13,931 t) followed by carangids (24,698 t).
- Oil sardine landings substantially increased from 39,000 t in 2006 to 66,624 t and now stands first in the landings.
- Among the demersals, silverbellies were dominant (47,887 t) followed by perches (29,135t) and elasmobranchs (9,820 t). Molluscan catch was dominated by cephalopods (10,306 t), whereas shrimps (19,041)t and crabs (12,566 t) dominated the crustaceans landings.
- The estimated marine fish landings in Puducherry was 14,721 t, which is 18% higher than the previous year.

Pelagic resources

- The major gear for the sardines was gillnetters. Dominant species among the lesser sardines was *Sardinella gibbosa* at Chennai and Tuticorin. At Chennai, L_∞ was estimated as 170 mm, K = 1.15, Z varied from 2.33 to 4.66. The F at 176 mm was 2.33. At Tuticorin, sardines were exploited below their optimum level indicating scope for increasing the catch.
- Anchovy landings were 10,837 t. Anchovies were mainly landed by artisanal gears. At Chennai, *Stolephorus commersoni* was dominant followed by *S. indicus* and *S. bataviensis*.
- The landing of carangids was 24,698 t caught mainly by trawlers. Carangids were represented by 38 species in Tuticorin. *Selar crumenophthalmus* and *Decapterus* sp. were dominant in the trawl, and *Caranx ignobilis* in hooks & line. *C. ignobilis* was found to be overexploited by the hooks & line.
- Ribbonfish landing was constituted by a single species (*Trichiurus lepturus*) at Chennai and Tuticorin. The size range of *T. lepturus* was 200-949 mm, with mean size of 517mm.
- Mackerel landing was 16,291 t during this year. At Chennai, *Rastrelliger faughni* was landed in considerable quantities (14.1%) in addition to *Rastrelliger kanagurta*. The size of *R. kanagurta* in trawl landings ranged from 100-429mm with mean size at 206.8mm. The growth parameters were L_∞ 260mm and K=1.3.
- The seerfish landing was 6,545 t. The landing was constituted mainly by *Scomberomorus commerson* at Tuticorin while at Chennai *S.*

guttatus formed 11.2% of the seerfish landings. Seerfish were found to be exploited at higher rate than the optimum level at Tuticorin.

- The total production of tunas was 14,130 t. Tunas were landed by drift gill net and hook and line. *Katsuwonus pelamis* formed 34.4%, *Auxis thazard* 33.3% and *Euthynnus affinis* 24% of the tuna landings at Chennai. At Tuticorin, *E. affinis* was the dominant species.

Dolphinfishes at Theresapuram (near Tuticorin)

Demersal resources

- Elasmobranch landing was estimated as 9,820 t. Rays dominated the landings at Chennai, Mandapam and Tuticorin. *Dasyatis jenkinsii* and *D. uarnak* formed dominant species at Chennai while *D. uarnak* and *H. bleekeri* dominated at Tuticorin and Mandapam. A noteworthy feature was the landing of triakid sharks in the trawl landings which formed 15% of the shark catch at Chennai.
- The landing of sciaenids was 8,559 t. Ten species were observed at Chennai of which *Otolithes ruber* and *Johnius carutta* were dominant. At Mandapam, *Pennahia macrophthalmus* formed 62% of the landings. Stock assessment studies of *Pennahia macrophthalmus* indicate that the stocks are exploited below optimum level (0.29).
- Goatfish landing was 5,374 t. Four Species were landed in the catches; *Upeneus taenipterus, U. bensasi* and *U. sulphureus* were landed at Chennai while *U. sundaicus* dominated the catches at Mandapam. Stock estimates on *U. sundaicus* indicate that the stock is exploited over optimum level (E = 0.65)
- Lizardfish landing was 2,372 t. *Saurida undosquamis* dominated the catches in the trawl landings at Chennai. *Trachinocephalus myops* landed in considerable quantities and greater degree of species diversity was observed with species like *S. tumbil, S. micropectoralis* and *Synodus indicus* also occurring in the catches.

Balistids in trawl landings

- Trawlers were the major gear for silverbellies landings. Siverbellies landing was 47,887 t by all gears. *Leiognathus splendens, Gazza minuta* and *L. bindus* were the three dominant species seen in catches at Chennai. At Mandapam, *L. jonesi* and *L. dussumieri* dominated. At Tuticorin, *L. splendens* and *L. dussumieri* were dominant in catches. At Mandapam (E = 0.71) and Tuticorin (E = 0.63) *L. jonesi* is subjected to heavy fishing pressure.
- Perches were landed mainly by the trawlers. Perches landing was estimated as 29,135 t. Lethrinids formed 9,288 t forming 31.8% of perch landings followed by lutjanids 2,111t (7.2 %) and groupers 2,285 t (7.8%). Among the lethrinids, *Lethrinus minialatus* was the dominant species forming 94% at Tuticorin and among groupers, *Epinephelus longispinis* dominated. The stock assessment studies indicate that both these species are exploited above the optimum level by the trawlers at Tuticorin. Among the threadfin breams, *Nemipterus japonicus* dominated at Tuticorin and *N. mesoprion* at Chennai. *N. japonicus* was exploited at levels higher than the optimum at Tuticorin.

Crustacean resources

- The total landing of crustaceans was 31,833 t. The shrimp landing was 19,041 t mainly caught by trawlers and crabs by drift gillnet. At Tuticorin, 6 species were landed by the trawl, out of which *P. semisulcatus* formed 87.4%. At Mandapam, *P. semisulcatus* contributed 66.8% to the landings.
- Crab landing was 12,566 t. At Chennai, 6 species occurred in the landings out of which *P. sanguinolentus* and *Podophthalmus vigil*

Galene bispinosa, a new crab resource at Chennai

Biological characteristics of important demersal species landed at Chennai and Tuticorin

Resource	Length range (mm)	Mean length (mm)	Percent occurrence of mature females
Dasyatis jenkinsii	140 - 1009	785	69.0
D. imbricatus	125 - 239	184.8	64.0
Otolithus ruber	100 - 319	161.4	2.4
Johnius carutta	100 - 219	158	35.5
Nibea maculata	100 - 249	163.1	33.9
Nemiterus japonicus (Chennai)	90 - 279	153.1	35.8
Tuticorin	120 - 330	230	28.6
N. mesoprion	90 - 199	137	26.4
N. bleekeri	80 - 239	143.7	30.5
N. peronii	115 - 249	164.2	37.2
Upeneus taeniopterus	80 - 179	116	51.0
U. sulphureus	90 - 149	123	32.0
Saurida undosquamis	90 - 410	184	9.7
Leiognathus splendens	60 - 120	96	30.0
Gazza minuta	45 - 125	100.5	35.0

dominated.. Emergence of *Galene bispinosa* as food for local consumption is a noteworthy feature during this year. At Mandapam, five species of crabs occurred in the landings and the commercial fishery was supported by *Portunus pelagicus*. Seven species of crabs were landed by bottomset gillnets (BSGN) at Tuticorin consisting of seven species.

- Lobster landings was 226 t. *Thenus orientalis* and *P. homarus* were landed by the trawlers and BSGN, respectively. *P. ornatus* was the dominant forming 60% in the BSGN landings at Kayalpattanam in Tuticorin in addition to *P. homarus* and *P. versicolor*.

Molluscan resources

- Cephalopod landing was estimated as 10,304 t. At Chennai, cuttlefish formed 67%, squid 26% and octopus 7%. Eleven species of cephalopods were landed at Chennai of which *Sepia pharonis* formed 24.6% and *S. aculeata* 16.7%. At Mandapam, cuttlefish constituted 64% and squid 18%. Among cuttlefish, *Sepia pharonis* formed 54%.
- Landing of gastropods was estimated as 791 t. At Chennai, 21 species occurred in the landings. The maximum catch was in October. *Hemifusus pugilinus* formed 21% of the landings. Biology of *Ficus gracilies* was studied. Spawning occured throughout the year. At Mandapam, *Xancus pyrum* var. *acuta* and *obtusa* occurred. At Tuticorin, *Chicoreus* and *Lambis* fishery was monitored from Kalavasal. The meat of these species is exported to southeast Asian countries.

Potential Yield

- Data on marine fish landings (t) and effort (efforts) expended along Tamil Nadu during 1989 to 2007 was used to estimate parameters of non-equilibrium Schaefer's surplus production model using a genetic algorithm. From 1998 onwards, the estimated Potential Yield is higher than the catch, which indicates that the catch can be increased. This is because the small pelagics, especially the oil sardine has emerged as a major fishery and is continuously increasing over the years.

PROJECT CODE DEM/IDP/02
PROJECT TITLE Development of management advisories for sustaining marine fisheries of Gujarat
SCIENTISTS **G.Mohanraj,** P.K.Asokan, Gulshad Mohammed and Subhadeep Ghosh
CENTRE Veraval

Catch of Ghol at Diu

- The estimated marine fish landing along Gujarat coast was 4.75 lakh t during 2007. The landings decreased by 6.5% compared to 2006. The pelagic landings were estimated as 1.66 lakh t forming 36% of the total production. The demersal resources contributed 35% (1.63 lakh t), followed by crustaceans 22% (1.01 lakh t) and cephalopods 7% (31,120 t).
- Multiday trawl operations aimed at exploitation of valuable target species with specific gears and in specific fishing grounds contributed 46 % to the total landings.
- Ribbonfish (31%) and Bombay duck (24%) were the major contributors to the pelagic fishery.
- Seerfishes (6%), tunas (6%), carangids (12%) and mackerel (5%) were the other commercially important pelagic resources.

- The major demersal resource was Sciaenids (37 % of demersal landings) represented mainly by *Otolithes cuvieri* and *Johnius glaucus*; catfishes (15%) and threadfin breams (14%) were the other dominant groups.
- Nonpenaeid shrimps formed 70% of the crustacean landings.
- *Acetes* spp. contributed more than 70% of the non-penaeid landings, followed by *Nematopalaemon tenuipes* and *Exhippolismata ensirostris.*
- Penaeid shrimps formed 17% of the crustacean catch.
- Ribbonfish (31%) and Bombay duck (24%) were the major contributors to the pelagic fishery.
- Seerfishes (6%), tunas (6%), carangids (12%) and mackerel (5%) were the other commercially important pelagic resources.

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- Penaeid shrimps formed 17% of the crustacean catch.

Catch of spiny lobsters at Okha

Revival of ghol & koth fishery

Nawabunder (dolnet) catch: ghol: 1946 t; koth: 1332 t
Veraval (trawl & gillnet) catch: ghol: 173 t; koth: 728 t
Diu (trawl & gillnet) catch: ghol & koth: 1302 t
Mean length (mm) of ghol: dolnet – 882.5; trawlnet (767.2)
Mean length (mm) of koth: trawlnet : 864.2
Mean weight: 15 kg
Price: Rs. 200-300 /kg

Juvenile ginger shrimp fishery at Surajbari

Season: July – September
Species: *Metapenaeus kutchensis*
Length range: 52 – 103 mm
Weight: 2 – 7 g
Price: Rs. 100/kg

Heavy landings of spiny lobster at Okha

Okha (trawlnet): –900 t
Diu (trawlnet): 11.33 t
Species: *Panulirus polyphagus*
Season: September- December
Mean carapace length: 91.2 mm
Mean body length: 248.6 mm
Mean body weight : 523.5 (g)

Bumper catches of silver pomfret

Nawabunder (dolnet): 130 t
Veraval (trawl & gillnets): 134 t
Diu (trawl & gillnets): 739 t
Mean length : 222.7 mm
Mean weight : 160 g
Annual income from silver pomfret
at Nawabunder, Veraval & Diu = Rs. 25 crores

Flourishing trade on air bladders at Okha

Air bladder of ghol: Rs. 6000-40000/kg
(depending on sex and weight)
Air bladder of koth: Rs. 3000-4500/kg
Annual income at Nawabunder, Veraval & Diu – Rs.70 crores
Air bladder of male ghol fetches double the price than that of female
Air bladder of eel: Rs. 4000-7000/kg
Air bladder of catfish: Rs. 550/kg

Emergence of fishery for purpleback squid

Scientific name: *Sthenoteuthis oualaniensis* (Lesson, 1830)
Landings at Veraval: 1500 kg
Dorsal mantle length: 400 – 535 mm
Price: Rs.20/kg

Population parameters for major pelagic resources of Veraval

Species	L_∞ (cm)	K/yr	Z/yr (P/B)	M/yr	F/yr	Q/B	Lc (cm)	E	U	t_0	phi prime
Trichiurus lepturus	126.7	0.11	0.47	0.28	0.19	5.6	37.0	0.40	0.15	-0.08	3.247
Harpadon nehereus	40.6	0.29	1.74	0.72	1.02	10.66	5.0	0.59	0.48	-0.07	2.680
Megalaspis cordyla	46.1	0.21	0.91	0.56	0.35	19.88	20.8	0.38	0.23	-0.09	2.650
Scomberomorus guttatus	641	0.69	1.84	1.12	0.73	13.7	24.4	0.40	0.33	-0.03	3.453
Coilia dussumieri	22.5	1.1	4.97	2.03	2.94	13.81	7.8	0.59	0.59	-0.01	2.747
Euthynnus affinis	79.8	0.33	5.37	0.65	4.72	11.62	_	0.88	0.88	-0.06	3.323
Auxis thazard	52.9	0.55	2.72	1.01	1.71	18.23	25.3	0.63	0.59	-0.04	3.187
Thunnus tonggol	99.5	0.16	0.72	0.38	0.34	15.94	41.8	0.47	0.24	-0.08	3.200
Caranx kalla	20.9	0.55	2.42	1.31	1.11	18.46	15.3	0.46	0.42	-0.05	2.380
Rastrelliger kanagurta	28.2	0.51	1.46	1.15	0.31	73.7	20.3	0.21	0.16	-0.05	2.608

Stock assessment and recruitment of major pelagic resources at centres in and around Veraval

Species	W_∞ (g)	Annual Yield (t)	Annual Stock (t)	Standing Biomass (t)	MSY (t)	Recruitment pattern
Harpadon nehereus	367	24677	51057	24193	21048	Trimodal – 1 major pulse (Feb-July) & 2 minor pulse (Sep & Nov)
Scomberomorus guttatus	1486	396	1185	542	499	Unimodal with peak during May to August
Coilia dussumieri	47	4340	7388	1476	3668	Continuous with peak from Feb to June
Euthynnus affinis	19850	314	358	66	178	Unimodal with peak during March to April
Auxis thazard	1000	146	248	85	116	Unimodal with peak during Sept to Oct
Thunnus tonggol	14087	1186	4894	3489	1256	Unimodal with peak during April to June
Caranx kalla	98	502	1202	452	547	-
Rastrelliger kanagurta	129	545	3343	1758	1283	Continuous with major peaks in Jan, March & May

PROJECT CODE MF / CAP /01

PROJECT TITLE **Developing management advisories for sustaining marine fisheries of Andhra Pradesh**

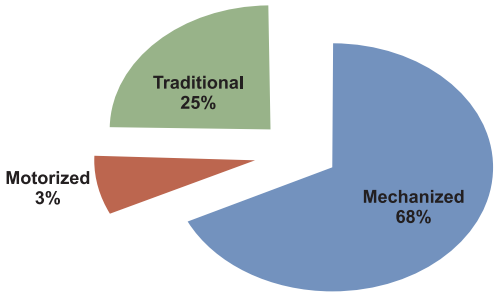
SCIENTISTS **G.S. Rao,** M. Srinath, G. Maheswarudu, Prathiba Rohit, S. Immanuel, U.R. Kumar (all CMFRI), R. Reghu and Rajeswari (both CIFT)

CENTRE Visakhapatnam

Highlights:

- An estimated 2,10,864 t of marine fish was landed along the Andhra coast during the period January to December 2007. Pelagic resources (55.2%) dominated the fishery followed by demersal (25.3%), crustacean (15.7%), molluscs (1.2%) and others (2.5%).
- The mechanized, motorized and the non-mechanized sectors contributed 67.7, 6.6 and 24.7%, respectively to the catch.
- The total marine fish landings of Andhra Pradesh decreased by 3.8% as compared to the corresponding period of the previous year. The catch as well as effort expended for fishing increased for all mechanized gears and decreased for other sectors.

- Trawl effort increased by 12.1 % and that by mechanized gillnets by 97.2%. The effort by the motorized seines decreased by 52.1%, motorized gillnets by 59.1% and motorized hook and lines by 33.5%.
- The catch by trawls registered an increase of 5.7% and that of mechanized gillnets quadrupled. The other gears recorded a decline in catch this year. The catch by the motorized and non-mechanized sectors decreased by 73.6% and 20.3%, respectively.
- The catches of sardines, mackerel, ribbonfish, nemipterids, lizardfish and goatfish decreased by 50, 48.8, 34.4, 5.3, 19.2 and 19.1% respectively. Seerfish, sciaenids, pomfrets and elasmobranchs catch increased by 64, 10.5, 61.3 and 1.9%, respectively as compared to the catch of the corresponding period in the previous year.



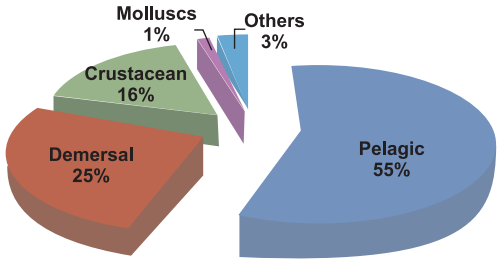
Sectoral contribution in Andhra Pradesh

Sector wise contribution of landings

- The trawls were the major gear contributing 44.8% followed by gillnets (33.1%), seines (13.3%) and hooks and line (7.0%).

Pelagic Resources

- The major pelagic resources supporting the fishery at Andhra Pradesh were sardines (8.7%), seerfish (5.5%), ribbonfish (5.1%), anchovies (5.1%), mackerel (3.0%) and tunas (1.0%).
- *Rastrelliger kanagurta* (96.3%) and *R. faughnii* (3.7 %) in mackerels, *T. lepturus* in ribbonfish, *Thunnus albacares* (56.4 %), *Katsuwonus pelamis* (23.1%) and *Euthynnus affinis* (20.5 %) in tunas, *Scomberomorus commerson* (68 %) and *S. guttatus* (32%) in seerfish and *S. gibbosa* and *S. longiceps* in sardines are the major species in different groups.



Group-wise contribution to landings

Demersal Resources

- Sciaenids and perches formed the major group among demersal fishes with a contribution of 5.1% and 5%, respectively. The important resources were elasmobranchs (3.9%), catfishes (2.3%) and silverbellies (2.1%).
- An estimated 3,227 t of threadfin breams were landed with a catch rate of 0.96 kg/hr forming 3.3 % of the total catch of mechanized trawlers. *Nemipterus japonicus* (51%) and *N.mesoprion* (21%), *N.delagoae* (13.6%) and *N. luteus* (2.8%) were the major species.
- Lizardfishes (1,718 t) formed 1.7 % of the total landings of mechanized trawlers. The catch rate was 0.49 kg/hr. *Saurida undosquamis* (41%), *S.tumbil* (35%), *S.longimanus* (20 %) are the major species.
- An estimated 10,382 t of sciaenids were landed by all gears together forming 4.9% of the total fish catch. Around 16 species contributed to the catch with *P.macrophthalmus* (25%) and *O.ruber* (21%) being the dominant species.
- An estimated 4,012 t of goatfishes were landed by all gears. The resource formed 3.7% of the trawl catch with a catch rate 1.0 kg/hr. The dominant species was *U.vittatus* (63%).
- An estimated 9928 t of pomfrets were landed which formed 4.7 % of the total fish catch. Mechanized gillnet (49%) and trawls (40.3%) mainly contributed to the catch. *P.chinensis* (56.9%), *P.argenteus* (38.7%) and *P.niger* (4.4%), were the species representing the catch.

Yellowfin tuna resources

Rainbow sardine catch from non-mechanised sector

- An estimated 8,126 t of elasmobranchs were landed during the year. Mechanized gillnet (36.9%) followed by mechanized hook and line (32.2%) and trawlers (19.6%) mainly contributed to the elasmobranch catch.
- The juveniles of dominant demersal fishes were observed in the catches during Jan-Feb (*N.japonicus*), April (*S.undosquamis*), July-December (*U.vittatus*) and October-December (*P.macrophthalmus*).
- Rapid survey for the availability of finfish seed resources was conducted along the north Andhra Pradesh coast over a stretch of 110 km from Visakhapatnam to Kalingapatnam. Juveniles of seerfish and mackerel were observed in large quantities especially in shoreseine operations during March and April. The live seerfish juvenile were collected from shore seines and reared in the laboratory for a period of 20 days.
- An estimated 2561 t of cephalopods were landed at the centre. The trawls landed 71.6% of the catch. Cepahalopods were represented by squids (5%) and cuttle (95%). *Loligo duvaucelli* was the dominant squid species. Cuttlefish was represented by *Sepia aculeata* (47 %), *S.pharaonis* (38%) and *S.inermis* (10%).

Crustacean Fisheries

- Penaeid shrimp landings were 24,787 t, which formed 11.75% of the total landings of Andhra coast.
- Penaeid shrimp catch has increased by 10.8% (2,409 t) due to increase in effort of mechanized trawlers by 24.7% and cph by 3.8% as well as increase in cpue of mechanized gill nets and motorized seines.
- Crab landings were 5,154 t, which formed 2.44% of the total landings.
- Crab catch decreased by 22.7% (1,510 t) due to decrease in cph of mechanized trawlers by 24.3%, decrease in the catch of motorized gill nets (74.9%) and non-motorized gill nets (53.9%).
- Penaeid shrimp catches was contributed by 23 species and *M. monoceros* (26.9%) dominated followed by *M. dobsoni* (18.9%), *S. crassicornis* (13.2%) and *P. indicus* (8.5%).
- Crab catch was constituted by *P. sanguinolentus* (77.4%), *P. pelagicus* (17.7%) and *Charybdis feriatus* (4.9%).

Length range, mean and sex ratio of important resources in trawlers

Species	Total length (cm)	Mean length (cm)	Sex ratio (M:F)
S. gibbosa	14.0-18.5	15.6	1:1.6
R. kanagurta	13.0-25.5	18.2	1:1
T. lepturus	28.0-104	52.1	1:1.9
S. guttatus	20.0-58.0	35.3	
N. japonicus	8.5-29.5	16.7	1:0.8
S. undosquamis	9.5-36.5	21.6	1:2.0
U. vittatus	8.5-21.5	14.0	1:1.2
P. macrophthalmus	11.5-26.5	18.2	1:1.5

P. argenteus	6.5-50.5	24.0	
P. niger	7.5-32.5	17.9	
M. monoceros	8.3-17.3(M)	12.5 (M)	1:2.5
	8.8-20.3 (F)	14.6 (F)	
M. dobsoni	5.3-10.3(M)	7.9(M)	
	5.3-11.3(F)	8.9(F)	1:2.2

Socioeconomic studies

- A socio-economic study was conducted on women involved in processing sector namely shrimp peeling, grading and packing. A total of 100 respondents were taken as study samples from two processing companies in the Mathruwada region of Visakhapatnam.
- Age of the respondents- 41% of the women involved in shrimp processing were young and 7% were middle aged. No one was found to be in the old category.
- Regarding education, 18% were illiterates and 22% had middle level of education.
- Wages are paid on monthly basis and it ranges between Rs. 1700 to Rs.4500 per month. Working hours varies between 09.00 to 21.00 hrs and it depends upon the arrival of the shrimp to the company. Only 7% had migrated from other states
- One month slary is paid as bonus to them. Festival advance upto Rs.2000 is provided to them. Medical check up is provided free of cost.
- Nearly 83% reported to prefer this job because they do not have any other alternative to earn income.
- Mean score was calculated regarding job perception-Physically compatible (0.66), income earning (0.58), working environment (0.58) and social security (0.51).
- The ergonomic problems faced by them were numbness (mean score 0.73), joint pain (0.71), back pain (0.59) and skin problem (0.37).

PROJECT CODE	**CF/IDP/02**
PROJECT TITLE	**Resource damage assessment in marine fisheries: impact of selective fishing of juveniles and by- catch and discards in trawl fisheries**
SCIENTISTS	**E. V. Radhakrishnan,** Subhadeep Ghosh, M. Zaffar Khan, Paramita Banerjee, A. P. Dinesh Babu, K. K. Philippose, P. P.Manojkumar, R. Sathiadhas, J. Jayasankar, Rekhadevi Chakraborty, M. Rajamani, S. Lakshmi Pillai, Shoba Joe Kizhakudan and G. Maheswarudu.
CENTRES	Veraval, Mumbai, Mangalore, Calicut, Cochin, Tuticorin, Mandapam, Chennai and Visakhapatnam

The bycatch and discards by trawlers and fish landing by selective fishing gears such as 'dolnets', 'minitrawls' and 'thalluvalai' were monitored.

- An estimated 17203 t of Low Value By-catch (LVB) with a catch rate of 24.86 kg/hr was landed by trawlers at Veraval during September to December. During September-October, 1567 t of bycatch was discarded at sea.
- 35 genera of finfishes and six genera of crustaceans were observed in the LVB. The value of LVB landed at Veraval during September to December is estimated to be Rs.34.4 million at the rate of Rs.2/kg.

The Low Value By-catch (LVB) includes both landed and discarded catch by trawlers. Single day trawlers (SDF) bring the entire bycatch whereas multiday trawlers (MDF) bring the LVB from last haul, except at Veraval where the entire bycatch is brought by the MDF. The biological and economic loss in terms of quantum of resource lost due to fishing of juvenile of commercially important finfishes and shellfishes is enormous. For example at Mangalore, the economic loss due to fishing of juvenile groupers is to the tune of Rs.14.7 crores.

Fish catch from experimental trawling

- At Mumbai 1671 t of bycatch with a catch rate of 200 kg/hr was landed during January to December 2007, which formed 22% of the total catch.
- Seventy three species of finfishes and shellfishes constituted the LVB and considering the size at first maturity, all were juveniles.
- At Mangalore, during September-December, an estimated 998 t of LVB was landed by multi-day (MDF) and 208 t by single day trawlers (SDF). MDF trawlers discarded 1255 t of LVB into the sea. 103 species of finfishes and shellfishes constituted the LVB.
- An estimated 2953 t of juveniles of *Epinephelus diacanthus* was landed as bycatch and 98.5 % of seerfishes landed by trawlers were juveniles.
- Twenty five species of commercially important fishes were recorded from the experimental trawl fishing. Reduction in mean size of *Nemipterus mesoprion* was noticed in 2007 (136 mm) compared to 147 mm in 2006.
- At Calicut, an estimated 28954 t of LVB was landed with a catch rate of 23.3 kg/hr. 60 species/groups constituted the bycatch and 81% were low value fishes/shellfishes.
- An estimated 234 t of juveniles of high value commercial species were present in the bycatch, of which *Saurida tumbil, Epinephelus diacanthus, Johniopsis sina* and *Nemipterus mesoprion* were the major species.
- Among crustaceans, juveniles of *Penaeus indicus* and *Portunus sanguinolentus* were the major species.
- An estimated 1633 t (29 % of total landing) LVB with a catch rate of 18.7 kg/hr was landed at Sakthikulangara, which was mostly constituted by fishes (17.3%), crustaceans (33.2%) and molluscs (10.3%). Multiday trawlers discarded 2/3 of the bycatch due to lack of storage facility.
- At Chennai, LVB including discards at sea amounted to 1689 t with a catch rate of 4.4 kg/hr. LVB formed nearly 14% of the total trawl landings.
- Fishes formed 66.5% of the LVB; crustaceans (26.2%) and molluscs (2.75%) formed the rest. Juveniles of commercially important fishes in the bycatch varied from 22.5% in September to 80.2% in July 2007. LVB which is not suitable for human consumption and used for fish meal was sold at Rs.4-5/kg and juveniles of major fish groups fetched Rs.40-80/kg.
- At Visakhapatnam, an estimated 2337 t of LVB was landed by trawlers at a catch rate of 2.8 kg/hr. The discards at sea was an estimated 8433 t. LVB constituted 10.7% of total landings.
- LVB was constituted by finfishes (72.4%), crustaceans (25%) and molluscs (2.5%). 48 genera/species of finfish and 13 genera/species of crustaceans constituted the bycatch. The estimated value of the LVB was Rs.40.9 lakhs.

Selective fishing gears

- 'Dolnet' catch at Mumbai was mostly constituted by juveniles of the Bombay duck *Harpadon nehereus* and the golden anchovy *Coilia dussumieri*.
- At Arnala, as estimated 1066.4 t of *H. nehereus* with a catch rate of 105 kg/unit was landed of which 88.2 % were juveniles. In Sassoon docks, 98.3% of *H. nehereus* landed (121 t) were juveniles.

- At Arnala, 89% of *C. dussumieri* landed were juveniles, whereas in Sassoon docks almost the entire catch of 18.5 t landed were juveniles.
- At Pallithode-Chellanam, Kerala an estimated 216 t of shrimps and fishes was landed by 'minitrawls' of which 87% (188 t) was constituted by shrimp. *Parapenaeopsis stylifera* (61%) and *Metapenaeus dobsoni* (37.8%) were the major shrimp species.
- An average 51% of *M. dobsoni* females landed was juveniles. If not caught and allowed to grow it would have fetched Rs.45.3 lakhs instead of Rs.3.7 lakhs for the juveniles.
- If the shrimps would have been allowed to mature and spawn atleast once, the total egg production would have been 46350 million, and the exploitation of juveniles has resulted in a massive biological loss to the fishery.
- An estimated 41.2 t of *P. semisulcatus* (May to December) with a catch rate of 2.9 kg/unit was landed by 'thalluvalai' at Tiruppalaikudi on the Palk Bay coast. The female shrimps measuring less than the size at first maturity (<125 mm) constituted 92% of the total landing.
- In November alone an estimated 7.8 lakh females of < 125 mm TL *P. semisulcatus* were landed at Tiruppalaikudy. At Mottagopuram, Tuticoirn, an estimated 11.9 t of juvenile shrimps (43-90 mm TL) with a catch rate of 1 kg/unit was landed by 'thallumadi'. The price of shrimps ranged from Rs.30-50/- kg compared to the price of Rs.200-250/kg for commercial size shrimps.

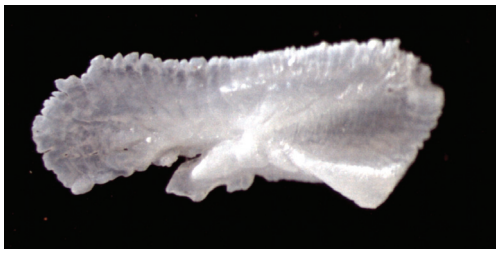
By-catch from single day trawlers

Centre-wise landing of Low Value By-catch (LVB) and its composition

Centre	Low Value By-catch (landed + discarded) (t)	Catch rate (kg/hr)	Composition
Veraval	17203*	24.9	35 genera of finfishes, six genera of crustaceans
Mumbai	1671	200.0	73 species of finfishes and shellfishes
Mangalore	1463*	-	103 species of finfishes and shellfishes
Calicut	28954	23.3	Fishes (30%), crabs (57.7%)
Sakthikulangara-Neendakara	1633	18.7	Fishes (17.3%), crustaceans (33.2%), molluscs (10.3%)
Chennai	1689	4.4	Fishes (66.5), crustaceans (26.2%), molluscs (2.75%)
Visakha-patnam	10770	2.8	Fishes (72.4%), crustaceans (25.2%), molluscs (2.5%).

* LVB landed during September-December

FUNDING AGENCY	**Ministry of Earth Sciences**
PROJECT TITLE	**Tuna Resources of the Indian EEZ - an assessment of growth and migratory patterns (Collaboration with FSI)**
SCIENTISTS	**N.G.K.Pillai,** U.Ganga and K.P. Said Koya
CENTRES	Cochin and Minicoy



A typical otolith of skipjack tuna

A typical otolith from yellowfin tuna

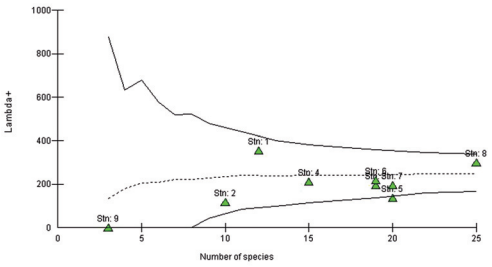
- DNA was extracted from *Katsuwonus pelamis* and *Thunnus albacares* landed at Cochin Fisheries Harbour, caught from Lakshadweep waters (Minicoy and Agatti) and for Yellowfin tuna caught from International waters (lat 22° and long 68°). Cytochrome-b gene of mt DNA of *K. pelamis* and *T. albacares* were amplified with specific primers and used for studying the stocks and mixing patterns. For the genetic divergence analysis, 599 bp-edited fragments was used and the relationship among populations were investigated using neighbour joining (NJ) and maximum parsimony (MP) algorithms in MEGA 3.2.. The results of the study revealed that the samples collected from these regions are genetically homogenous.
- Otoliths were used from Skipjack and Yellowfin tuna to study variations in its morphometry as well as relation to fish size and possible application for aging studies.

FUNDING AGENCY	**Marine Products Export Development Authority**
PROJECT TITLE	Participatory management and conservation of lobster resources along the Indian coast
SCIENTISTS	**E.V. Radhakrishnan,** B. Meenakumari and P. Pravin (CIFT)
CENTRE	Cochin

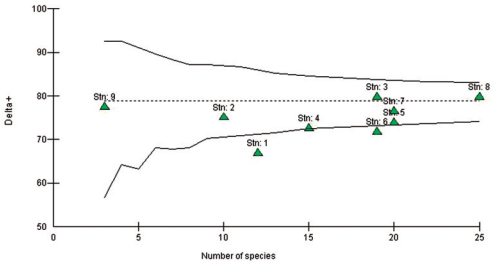
- 100 lobster traps were fabricated by CIFT for distribution to fishermen at Enayam and Kadiyapatnam.
- Posters and pamphlets in vernacular languages (Tamil, Gujarati and Marati) were distributed to fishermen through NGOs.
- The English version of video film on lobster conservation was completed. Dubbing in Gujarati and Hindi were also completed.

FUNDING AGENCY	**Ministry of Earth Sciences**
PROJECT TITLE	**Stock assessment and biology of deep-sea fishes in the continental slope of Indian EEZ**
SCIENTISTS	**A.A.Jayaprakash** and U.Ganga
CENTRE	Cochin

- The deep-sea demersal finfishes in the shelf edge off North Andaman were studied based on trawl survey at nine stations by FORV *Sagar Sampada* (Cruise No.252) during January to February 2007. HSDT-CV and EXPO demersal trawl net were employed in continental shelf edge at depth ranging from 300 to 700m.
- A total of 63 species of finfishes belonging to 53 genera, 42 families and 19 orders were recorded. The highest abundance was recorded at Station No. 8 with 25 species and lowest at Station No. 9 with 3 species.
- The data were further analyzed using PRIMER software for species indices, cluster analysis and taxonomic distinctness. It was found that Shannon Weiner indices were high at Station 8 with a value of 2.51 and low at station 1 with a value of 0.6. Simpson indices were high in Station 7 and a low in Station 1. Margalef Species Richness showed a maximum at Station 8 with a value of 3.88 and a low at station 9 with a value of 1.11. Species evenness calculated indicated that they were evenly distributed at Stations 2 to 9 and uneven distribution was observed at Station 1.
- The 95% confidence funnel was generated for the variation in taxonomic distinctness and average in taxonomic distinctness. It indicated that all the stations fell within the confidence funnel showing no deviation from the normal in variation of taxonomic distinctness. Average taxonomic distinctness calculated and plotted indicated that all the stations fell within the confidence level except Station 1 and 6, which deviated outside the funnel.



The 95% confidence funnel for variation taxonomic distinctness values (lambda+) showing normal distribution of deep sea finfishes in Andaman sea.



The 95% confidence funnel for Average taxonomic distinctness values (delta+) showing deviation from normal distribution in station 1 and 6 in Andaman sea

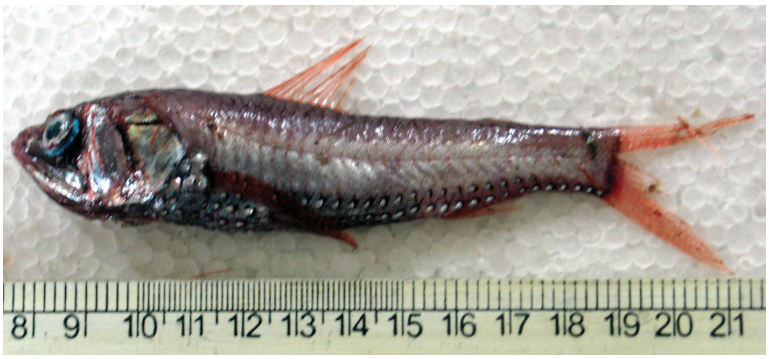
Finfish species recorded from north Andaman seas

Species	Family
Alepocephalus bicolor	Alepocephalidae
Apristerus indicus	Scyliorhinidae
Argyropelecus hemigymnus	Sternoptychidae
Astronesthes martensii	Astronesthidae
Astronesthis lucifer	Astronesthidae
Bathyclupea elongata	Bathyclupeidae
Bathypterois dubius	Chlorophthalmidae
Bembrops caudimaculata	Percophidae
Benthobatis moresbyi	Torpedinidae
Brotualtenea crassa	Ophidiidae
Centrophorus scalpratus	Squalidae
Chanux pictus	Chaunacidae
Chauliodus sloani	Chauliodontidae
Chlorophthalamus bicornis	Chlorophthalmidae
Chlorphthalamus trunctatus	Chlorophthalmidae
Coelorinchus braueri	Macrouridae

Deep water sting ray *Plesiobatis daviesi* from north Andaman waters

Sorting of catch on deck of FORV *Sagar Sampada*

Coryphaenoides macrolophus	Macrouridae
Cryptopsaras couesii	Ceratiidae
Cubiceps sp.	Nomeidae
Cubiceps baxteri	Nomeidae
Cubiceps pauciradiatus	Nomeidae
Cyclothone braueri	Gonostomatidae
Diaphus effulgens	Myctophidae
Dicrolene multifilis	Ophidiidae
Dicrolene sp.	Ophidiidae
Epigonus pandionis	Apogonidae
Eridacnis radcliffei	Proscylliidae
Ateleopus barnardi	Ateleopodidae
Laeops macropthalmus	Bothidae
Halieutaea cocinea	Ogcocephalidae
Idiacanthus fasciola	Gonostomatidae
Lamprogrammus sp.	Ophidiidae
Lophius sp	Lophiidae
Nezumia propinqua	Macrouridae
Malacosteus niger	Malacosteidae
Malacosteus sp.	Malacosteidae
Macroramphosus uradoi	Solenostomidae
Melanocetus johnsoni	Melanocetidae
Nemichthys scolopaceus	Nemichthyidae
Neoharriotta pinnata	Rhinochimaeridae
Neoepinnula orientalis	Gempylidae
Neoscopelus microchir	Neoscopelidae
Serrivomer beanii	Serrivomeridae
Owstonia weberi	Cepolidae
Paratriacanthodes retrospinis	Triacanthodidae
Peristedion barberi	Peristediidae
Peristedion investigatoris	Peristediidae

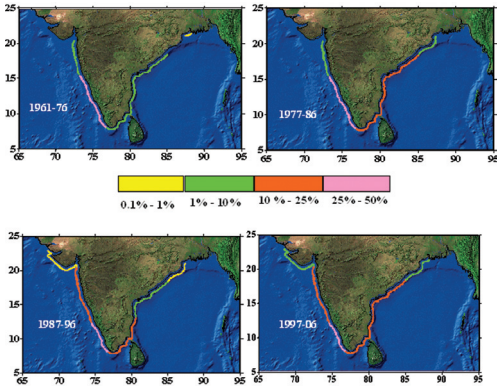


The Black-chin *Neoscopelus microchir*

FUNDING AGENCY	**ICAR Network Project**
PROJECT TITLE	**Impact, adaptation and vulnerability of Indian marine fisheries to climate change**
SCIENTISTS	**E. Vivekanandan,** M. Rajagopalan, N. G. K. Pillai, K. S. Mohamed, J. Jayasankar, P.K. Krishnakumar, K. Vijayakumaran, H.M. Kasim, Joe Kizhakudan and V.V.Singh
CENTRES	Cochin, Chennai, Mumbai, Mangalore and Veraval

Adaptation by the Indian mackerel *Rastrelliger kanagurta*

The Indian mackerel *Rastrelliger kanagurta*, one of the commercially important pelagic fish, is able to adapt to rise in sea surface temperature by extending distribution towards northern latitudes, and by descending to depths. During 1961-76, the mackerel catch along the northwest coast of India contributed about 7.5% to the all India mackerel catch, which increased to 18% during 1997-06. In the northeast coast, the mackerel catch contributed 0.4% to the all India mackerel catch during 1961-76, which increased to 1.7% during 1997-06. Mackerel was conventionally caught by surface drift gillnets by artisanal fishermen. However, in recent years, the fish is increasingly getting caught in bottom trawl nets operated by large mechanized boats at about 50 m depth. In 1985, only 2% of the total mackerel catch was from bottom trawlers. In the last five years, about 10% of the mackerel catch is by the bottom trawlers. This shows that the fish descends down to overcome warmer surface waters.



Extension of northern boundary of Indian mackerel

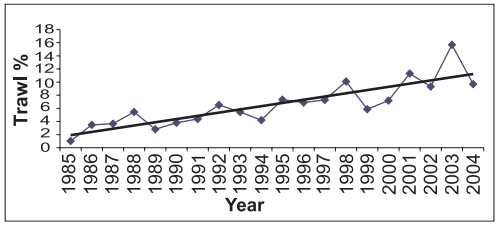
Carbon Footprint by marine fishing boats

Data were collected on the diesel consumption of about 1332 mechanized boats and 631 motorized boats in the major fishing harbors along the east and west coasts of India. Initial estimates indicate that the fossil fuel consumption by marine fishing boats is around 1200 million litres per year and CO_2 emission by the marine fishing sector is around 2.4 million tonnes per year.

Inventory on vulnerability of coastal fishing villages

Many of the coastal fishing villages are vulnerable to sea level rise as they are located close to the sea shore. To identify the most vulnerable villages, a survey on the distance from high-tide line (HTL) to each fishing village was undertaken.

Demographic details and infrastructure available in the fishing villages of maritime states were collected. There are about 2643 fishing villages along the Indian coast, of which 458 are within 100m from the high tide line. The population in the 458 coastal fishing villages is around 1 million. The largest number of coastal fishing villages (about 200) within 100m are in Kerala. The data on vulnerable fishing villages will be useful to sensitize the fishing communities on the perils of rising sea level and to take up appropriate disaster management.



Increasing contribution of bottom trawls to the mackerel catch

PROJECT CODE	MF/CAP/02
PROJECT TITLE	**Application of trophic modelling in marine fisheries management**
SCIENTISTS	**K.S. Mohamed,** M. Srinath, E. Vivekanandan, P.U. Zacharia, T.V. Sathianandan, V.D. Deshmukh, M.Z. Khan, V.V. Singh, Paramita Banerjee, G. Mohanraj, P.K. Asokan, S. Ghosh, V. Venketasan, Bindu Sulochanan, E.M. Abdussamad, K.K. Joshi and P.S. Asha
CENTRES	Cochin, Mumbai, Veraval, Chennai, Mandapam and Tuticorin

Northwest Coast (NWC) Ecosystem

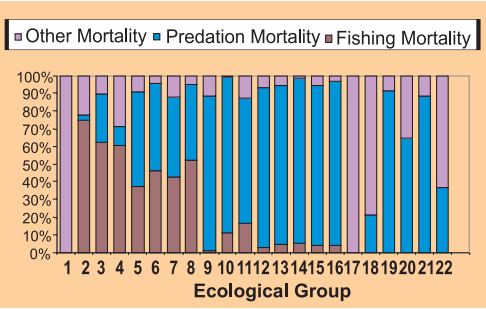
Mass balance was achieved for the NWC ecosystem model. The model had 23 ecological groups, out of which 21 were consumers ranging from dolphins and porpoises to micro-zooplankton. One group was a primary producer, *viz.*, phytoplankton and one was a detritus group. Separate single species groups which were created were Bombay duck, Whale shark and Acetes shrimp, considering their pivotal role in the NWC ecosystem (see table).

Group number	Ecological group name
1	Dolphins & porpoises
2	Large pelagics
3	Large benthic carnivores
4	Rays & skates
5	Medium benthic carnivores
6	Small benthic carnivores
7	Mid-water carnivores
8	Bombay duck
9	Small pelagic herbivores
10	Small pelagic carnivores
11	Cephalopods
12	Benthic omnivores
13	Non-penaeid shrimps
14	Penaeid shrimps
15	Crabs & Lobsters
16	Acetes shrimp
17	Whale sharks
18	Benthic epifauna
19	Benthic infauna
20	Large zooplankton
21	Small zooplankton
22	Phytoplankton
23	Detritus

The summary system statistics of the NWC ecosystem is shown in table.

The total system throughput, which is the sum of all flows, was estimated as **7492 t/km²/ year**, which is in harmony with estimates in other tropical ecosystems, and is indicative of a system with medium turnover. The mean trophic level of the catch was estimated as **3.49** which is higher than that of the Karnataka and Southwest coast models and indicative of dominance of predatory animals in the ecosystem. Several ratios, such as; gross efficiency, total primary production/total respiration, total primary production/ total biomass, total biomass/ total throughput and net system production; indicate that the NWC ecosystem is immature and is in the process of achieving maturity. Both the connectance index and system omnivory index were relatively high indicating the high degree of biological and feeding interactions within the ecosystem and displays the web-like features of the ecosystem.

Parameter	Value	Units
1. Sum of all consumption	1982	t/km²/year
2. Sum of all exports	2064	t/km²/year
3. Sum of all respiratory flows	1000	t/km²/year
4. Sum of all flows into detritus	2446	t/km²/year
5. Total system throughput	7492	t/km²/year
6. Sum of all production	3652	t/km²/year
7. Mean trophic level of the catch	3.49	
8. Gross efficiency (catch/net p.p.)	0.001551	
9. Calculated total net primary production	3064	t/km²/year
10. Total primary production/total respiration	3.063	
11. Net system production	2064	t/km²/year
12. Total primary production/total biomass	43.71	
13. Total biomass/total throughput	0.009	
14. Total biomass (excluding detritus)	70.097	t/km²
15. Total catches	4.753	t/km²/year
16. Connectance Index	0.413	
17. System Omnivory Index	0.335	



Mortality coefficients of different ecological groups in NWC ecosystem

The mortality coefficients of different ecological groups revealed that while larger predators like marine mammals, sharks, rays and large benthic carnivores had low degree of predation mortality; lower trophic level animals

had high degree of predation mortality. The proportion of fishing mortality was very high for large pelagics, rays and skates and large benthic carnivores.

The flow diagram of the NWC ecosystem is shown below. Boxes representing organisms low in the food web are placed in the lower part of the graph, along with phytoplankton and detritus, while organisms high in the food web are placed higher. Flows from boxes are represented by lines.

The ecological footprints of the organisms in the NWC ecosystem are directly proportional to the primary production required for harvest of each group and is shown in figure. Maximum footprints are left by group 5 (medium benthic carnivores); group 6 (small benthic carnivores); group 7 (mid-water carnivores) and group 8 (Bombay duck).

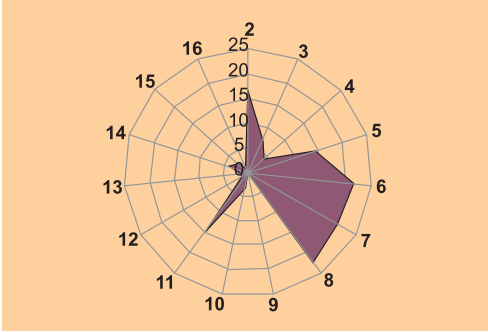
High footprints were also seen for group 2 (large pelagics which includes sharks) and group 11 (cephalopods).

Gulf of Mannar (GOM) Ecosystem

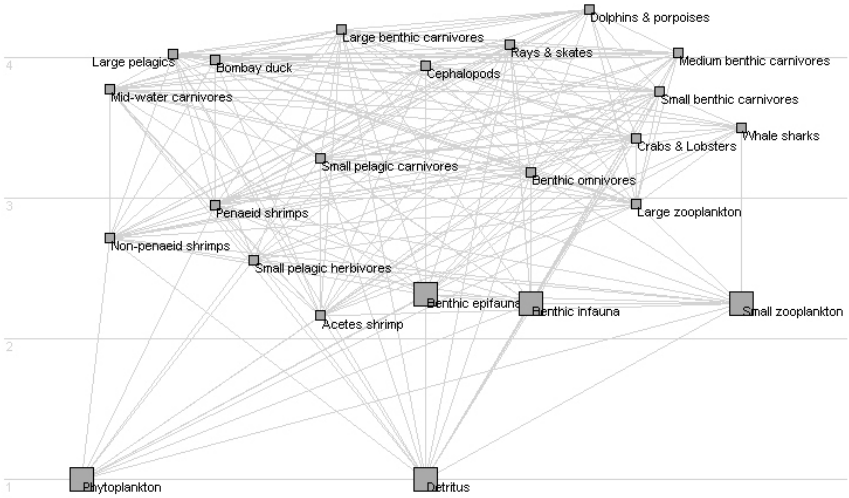
Ecological Groups & Fleets: More ecological groups were created for GOM (33 nos). Maximum non-fishery groups (16 including detritus) were created for GOM. Turtle group was split into herbivorous (green turtle) and carnivorous (rest) based on feeding. 34 craft-gear combinations were consolidated into 7 fleets *viz*., MTN, MDTN, Bottom set gillnet (BSGN), DGN, H&L, Seines and Artisanal gears (ARS).

Ecopath Data Input Collation: More species groups were covered during the year for input data collection with special reference to gastropods and reef fishes.

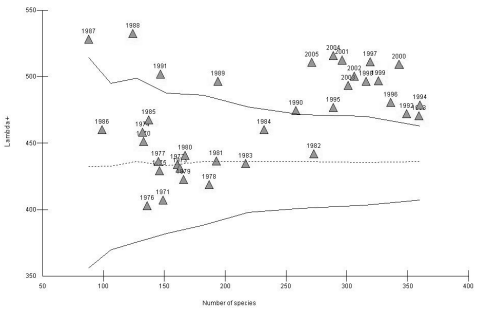
However, mass balance of the model could not be achieved during the year, as more data needs to be collated.



Primary production required for harvest of ecological groups



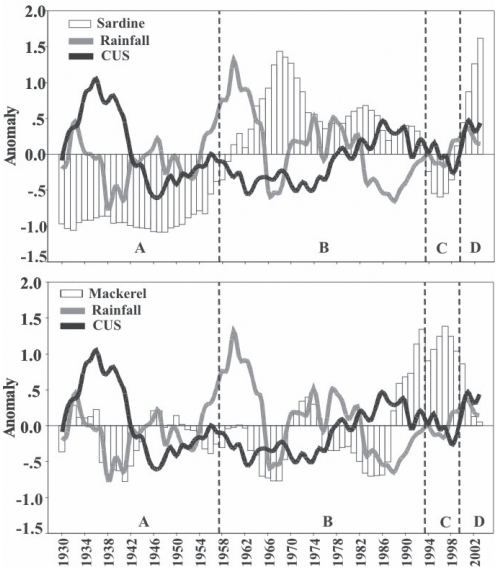
FUNDING AGENCY	**ICAR-AP Cess Fund**
PROJECT TITLE	**Assessing the impact of fisheries on the biodiversity of marine fish resources of Southwest coast of India**
SCIENTISTS	**K. S. Mohamed,** P.U. Zacharia, P.K. Krishnakumar, T.V. Sathianandan and P.K. Asokan
CENTRES	Kochi, Veraval, Tuticorin and Chennai



Variation taxonomic distinctness funnel plot showing stressed years in Kerala

During the year, detailed analysis were made on the collated historic data. The following aspects relating to data archaeology were covered.

1. Conversion of NMLRDC landing data from 83 species groups to actual (more than 800 species) in Kerala & Karnataka – 1970 to 2006
   - Alpha, Beta & Gamma Diversity for each fishery zone
   - Identification of stressed/disturbed habitats by species presence/ absence – Average Taxonomic Distinctness/ Variation TD
   - Mean Trophic Level Analysis of the fishery
   - Creation of Taxonomic Trees
   - Change in Species Ranking
   - Markov Chain Analysis
   - Listing of Rare & Common species by frequency of occurrence
2. Collation of length frequency data from 1926 from records of Madras Presidency Fisheries Annual Reports & BIOBASE for oil sardine and mackerel
   - Evaluation of size-based indicators – Lmean, Lmin, Lmax
3. Collation of SST, CUI (coastal upwelling index) and ENSO for the same period
   - Identification of Optimum Environmental Window for Oil Sardine & Mackerel



Six point moving average of anomalies of CUS and rainfall plotted against anomalies of oil sardine landing (top panel) and Indian mackerel landing (bottom panel) along the west coast of India during 1926- 2005. A) mackerel dominated period during 1926-1956, B) sardine dominated period during 1957 - 1992, C) mackerel dominated period during 1993-1998 and D) sardine dominated period during 1999-2005.

Identification of stressed habitats (zones)

Based on presence-absence data, funnel plots were made showing Average Taxonomic Distinctness (AvTD - Delta+) and Variation Taxonomic Distinctness (VarTD – Lambda+) against species richness for Kerala and Karnataka during 1970-2005. The funnel delineates the 95% simulation limit, while the dotted line represents the taxonomic mean value of the respective index, both established by the master species list. The plots show that sampling events for "+ generally fall below the mean line and that for Ë+ lie above the mean line and also outside the confidence funnel indicating a marked change from the expected.

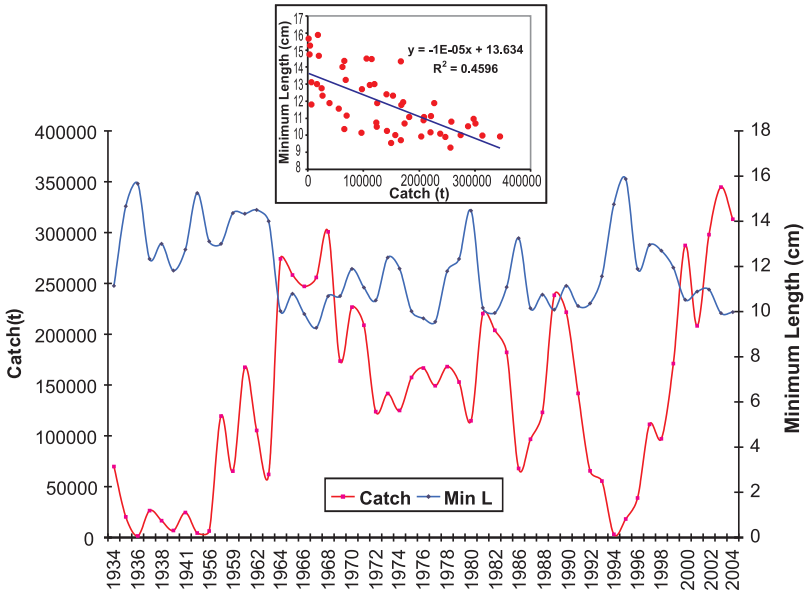
How environmental parameters influence fluctuations in oil sardine and mackerel fishery during 1926–2005 along the southwest coast of India

Inter-annual fluctuations in oil sardine catches were very high when compared to mackerel. Significant inverse relationships were not observed between the catches of oil sardine and mackerel. Catches of the both species were not having any significant relationships with sunspot activity, ENSO or rainfall. Both the species were exploited by the same gear, from the same area and almost during the same period and hence, over exploitation may not be the reason for the collapse of oil sardine fishery during early 40s and in 1994. The spawning and recruitment period of

oil sardine was over lapping with the major upwelling season of June to September along the Malabar Coast, while mackerel was having relatively extended spawning and recruitment period. Therefore during certain years, the unfavorable environmental conditions associated with intense upwelling might have affected the successful spawning and recruitment of oil sardine. The revival of oil sardine fishery in mid 50s and late 90s coincided with the heavy rainfall.

Use of size-based indicators for evaluating long-term trends in Indian oil sardine (*Sardinella longiceps*) fishery

SBIs are a cost-effective tool to evaluate the effects of fishing on a population of fish, and have been used for several temperate water species such as cod and plaice. The results obtained are in contrast to what has been observed for temperate water stocks, where a decrease in mean length and maximum length can signify adverse fishing effects on the population. In the case of oil sardine, L_{mean} was not a good predictor of stock health, probably because of the fast growth rate and the presence of multiple broods in the population. The L_{min} was however a reasonably good predictor of recruitment success and eventually a good fishery.



Striking inverse relationship between L_{min} and catch of oil sardine and inset shows scatter plot showing inverse relationship between L_{min} and catch

PROJECT CODE	**FEM/01**
PROJECT TITLE	**Impact of anthropogenic activities on coastal marine environment and fisheries**
SCIENTISTS	**P. Kaladharan,** M. Rajagopalan, P.K. Krishnakumar, P.K. Asokan, V.V. Singh, K. Vijayakumaran, D. Prema, P.S. Asha and Bindu Sulochanan
CENTRES	Visakhapatnam, Chennai, Veraval, Mumbai, Mangalore, Cochin, Tuticorin and Mandapam Camp.

The main objective of the project is to assess the degradation of sensitive and threatened marine habitats due to various anthropogenic activities taking place along the Indian coast.

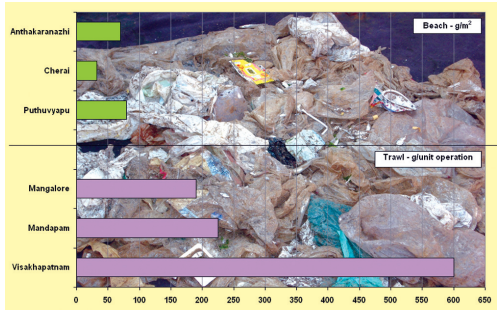
The impact of urban domestic sewage and other anthropogenic activities, were studied based on monthly monitoring of environmental parameters such as CO_2, pH, SST, BOD, TSS, salinity, NH_3, dissolved nutrients, primary productivity, chlorophyll pigments and quantity of plastics and other non-degradable materials from 32 stations out of 8 coastal centers along the maritime states of our country. The annual mean values of the observed environmental parameters from the outfall area and the reference sites are given in the Table.

Centres / Parameters	Domain	Visakha-patnam	Chennai	Mand-apam	Tuti-corin	Cochin	Mangalore	Mumbai	Veraval
CO_2 (mg/l)	Outfall	11.5	0	ND	28.3	ND	ND	73	ND
	Reference	0	0	ND		ND	ND	27	ND
NH_3 (µg/l)	Outfall	88.5	0.82	5.10	754	0	0	ND	ND
	Reference	0.89	0.77	0.49	125	0	0	ND	ND
TSS (mg/l)	Outfall	45.6	22.0	46.0	236	75.0	600	120	193
	Reference	27.0	23.0	38.0	210	18.1	157	520	210
BOD (mg/l)	Outfall	1.75	ND	ND	2.38	3.45	6.0	12.0	ND
	Reference	ND	ND	0.79	1.76	6.0	8.0	ND	
pH	Outfall	7.6	ND	7.9	8.0	5.92	7.99	7.19	7.16
	Reference	8.2	ND	8.0	8.12	8.09	8.0	8.08	7.67
Temp (°C)	Outfall	28.8	30.1	31.0	30.5	29.0	28.1	32.5	32.2
	Reference	26.9	30.5	29.8	28.5	30.0	27.9	30.5	32.0
Salinity (ppt)	Outfall	25.32	32.6	33.7	33.0	2.81	30.8	12.4	16.6
	Reference	29.9	33.7	34.3	31.7	22.4	31.0	35.2	28.3
Chl a (mg/m^3)	Outfall	0.88	ND	0.40	7.75	1.21	0.76	5.3	ND
	Reference	0.375	ND	0.35	2.57	0.09	0.48	0.3	ND
Plastics (g/trawl)		600	ND	225	ND	ND	190	ND	ND

Plastics at Farm pond station : Mandapam

- *Discarded net recovered from inshore waters* : One bottom set gill net was recovered from inshore waters of Visakhapatnam (17° 43' 305"N; 83° 25' 736"E) at a depth of 39 m. The gill net soaked in mud was 52 m long and 6 m height with 2.5 cm mesh made of monofilament thread. Three crabs, 2 puffer fish and 12 gastropod shells (*Murex* sp.) were found entangled. This net was hauled from an area of 0.093 sq. km.
- *Plastics from fishing grounds* : Plastic materials weighing on an average 190 - 500g per operation, containing mostly carry bags, sachets, drinking water covers, biscuit covers, plastic cups etc. were collected from shore seine nets and trawl nets along the coasts.

- *Oil spill* : On 20th February 2008, oil slicks off Rushikonda was observed while on board RV CIFTECH-I spread over an area of 17° 42' 728" N & 83° 23' 984" E to 17° 42' 795" N & 83° 24' 142" E.
- *Impact of open cage sea farming* : Fortnightly or monthly observations made from the floating cage established for farming Asian sea bass revealed no marked changes in the water quality parameters.
- *Ship breaking activity at Alang, Gujarat* : More than 3677 marine vessels were broken at the yard from 1983 to 2003 representing over 27 million LDT (light displacement tonnage). Several asbestos pieces, plastic waste, paint chips, metal pieces, tar balls, sludge, glass and ceramics were found scattered on the beach and inter-tidal area.
- *Beach contamination* : Observations on beach contamination with reference to solid waste and plastics carried out monthly from 3 beaches along Kochi showed an average weight of 79 g/m^2 plastics at Puthuvypu, 32.56 g/m^2 Cherai and 69.4 g/m^2 at Anthakaranazhi.



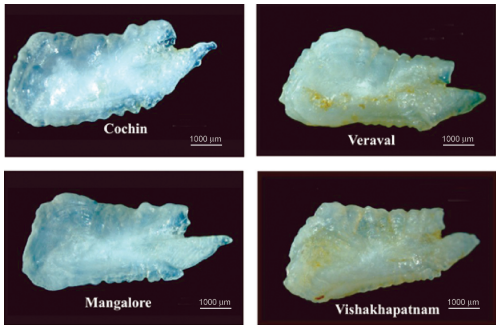
Assessment of plastics in trawl and beaches


Scum formed due to oil and iron ore : Mangalore

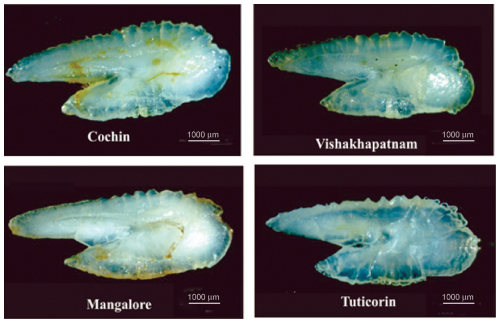
PROJECT CODE	**FEM/02**
PROJECT TITLE	**Impact and yield study of environmental changes on the distribution shift in small pelagics along the Indian coast**
SCIENTISTS	**P.K. Krishnakumar,** M. Rajagopalan, V. Chandrika, P. Kaladharan, Prathibha Rohit, T.V, Sathianandan, D. Prema, K. Vijayakumaran, V.V. Singh, P.S. Asha, U. Ganga, Bindu Sulochanan and Subhadeep Ghosh
CENTRES	Veraval, Mumbai, Mangalore, Cochin, Tuticorin, Mandapam, Chennai and Vishakhapatnam

The project is directed to understand the fluctuations in the abundance of marine fisheries in relation to changes in the environment and human interventions. Historically, the distribution of sardines and mackerels were restricted to the Malabar upwelling system along the southwest coast (8° – 16 ° N latitude) of India. However, a clear cut distribution shifts in these two species were observed since 1989. Hence, the objective of the project is to investigate the role of physical and biological variable in the habitat shifting/switching of small pelagic such as oil sardine and mackerel along the Indian coast.

- Fishery related environmental parameters such as SST, salinity, dissolved oxygen content, nutrients and chlorophyll a were regularly monitored from the inshore waters.
- Phyto and zooplankton samples were collected from the inshore waters regularly to study the occurrence of some of the known prey organisms of oil sardine and mackerel.
- Morphometric measurements of sardine and mackerel were carried out for truss analysis and the truss measurement data were subjected to Principal Component Analysis to identify variations in fish stock.
- Otolith samples of sardine and mackerel were collected from individual fishes every month, washed thoroughly, dried, photographed and stored for analysis of calcium and strontium levels and stable oxygen isotopes (O^{16} & O^{18}).



Mackerel otolith



Oil sardine otolith

Microphotograph of mackerel and oil sardine otolith

- Prey organisms of oil sardine and mackerel such as diatoms (*Coscinodiscus* sp., *Rhizosolenia* sp., *Biddulphia* sp., *Thallasiothrix* sp., *Fragilaria* sp., *Pleurosigma* sp., *Nitzschia* sp., etc), dianoflagellates (*Ceratium* sp., *Dinophysis* sp., *Peridinium* sp., *Porocentrum* sp. etc.) and zooplankton (Copepods, Cladocera, Lucifer, Mysids, Sagitta, Ctenophores, Stomatopod larvae, Decapod larvae, Chaetognaths etc.) were observed both along the east and west coast of India in substantial quantity.
- Truss analysis of mackerels showed that Veraval sample is morphometrically different from those at Visakapatanam and Mandapam.
- Otolith morphology of oil sardine from both the coasts was similar, while the mackerel otolith was having some morphological variations with sampling locations.
- Otolith of mackerel samples from Mangalore and Cochin having heavy river discharge were having low Sr:Ca ratio compared to the samples collected from Veraval and Chennai having very low river discharge into the sea.
- Generally, study shows that prey organisms of oil sardine and mackerel are available along the coastal waters of India and it may not be a limiting factor in their distribution.
- Preliminary studies shows that truss analysis and otolith chemistry is very useful in identifying the fish stocks.

FUNDING AGENCY	**Ministry of Earth Sciences**
PROJECT TITLE	**Studies on marine mammals of Indian EEZ and the contiguous seas**
SCIENTISTS	**M. Rajagopalan,** E. Vivekanandan, P.K. Krishnakumar, P. Jayasankar and K.P. Said Koya
CENTRES	Cochin, Mangalore, Chennai, Mandapam Camp, Visakhapatnam and Minicoy

The four-year project was completed in September 2007. The project has provided valuable information for gaining an insight into the (a) temporal and spatial distribution of marine mammals in the Indian EEZ and the contiguous seas, (b) incidental dolphin kills in fishing gears, (c) molecular taxonomy, and (d) trace metal and organochlorine pesticide loads in the tissues of marine mammals. As an outcome of the project, following recommendations have been made:

- Abundance estimates on dolphins, porpoise, dugong and whales have to be made in space and time.
- Fishermen need to be educated on the importance of marine mammals in the ecosystem. This will help reducing the incidental capture of marine mammals in fishing gears.
- The concentration of trace metals and organochlorine pesticides in marine mammal tissues are mostly within safe limits. However, continuous monitoring on pollutant concentration in the tissues of marine mammal is necessary.
- For validation of species identity, sex identification, and to check illegal trading, it is important to strengthen molecular techniques on marine mammals.
- The research and conservation efforts on dugong need to be intensified.

Balaenoptera musculus (off Southern Sri Lanka)

- Training should be conducted as a measure of capacity building to the officials of Forest and Wildlife Departments, Fisheries Departments and other stakeholders on different aspects of conservation.
- Ecotourism on marine mammals may be promoted along the coast between Cochin and Calicut, Mangalore and Goa, south of Kanyakumari and off Visakhapatnam.

A workshop on the scientific findings of the project was conducted on July 25, 2007 at CMFRI, Cochin.

The following two CD-ROMs were prepared under this project:

1) Marine Mammal Atlas

2) Molecular Taxonomy & PCR based Gender Identification

Honourable Minister of Science & Technology and Earth Sciences, Shri Kapil Sibal released the CD ROMs in a press conference on 7th April 2008 at New Delhi.

Application of molecular taxonomy for species identification of market samples

On the basis of information received from the fish market near Narakkal junction, on 15th September 2007, the scientists from MBTD visited the market and required information and samples were collected for identification using molecular taxonomy. The animal was chopped into several pieces by the time it could be examined and nothing was left for the identification of the species based on morphology. The skin tissue was preserved in 70% ethanol and genomic DNA was extracted. By the techniques standardized in the laboratory, PCR, sequencing and sequence analysis were carried out. MtDNA control region and cytochrome b sequences were deposited in GenBank (www.ncbi.nlm.nih.gov/) under the accession numbers EU204618 and EU204619. Phylogenetic reconstruction in *DNA Surveillance* (www.cebl.auckland.ac.nz:9000/) has unambiguously recognized the species as spinner dolphin (*Stenella longirostris*), proving the application of molecular taxonomy in species identification. With the help of conventional taxonomy, such a feat would have never been possible.

Tursiops aduncus (off Calicut), a cetacean sighted during FORV *Sagar Sampada* Cruise

Neophocaena phocaenoides (off Gangoli)

Sousa chinensis (off Gangoli), a cetacean caught incidentally

PROJECT CODE	**SEE / PEM/ 01**
PROJECT TITLE	**Benefit cost analysis of marine fishery business enterprises and alternative investment options**
SCIENTISTS	**R.Sathiadhas** and R.Narayanakumar
CENTRES	Cochin and Visakahapatanam

- Cost and earnings data collection was initiated in six locations each in Kerala and Tamilnadu (Munambam, Kochi, Neendakara, Valanjavazhi, Omanappuzha, Vizhinjam in Kerala and Chinnamuttam, Tuticorin, Thresapuram, Alanthalai and Colachal in Tamil Nadu). The economic performance of different fishing units was assessed by working out the economic indicators like total operating cost per trip, gross revenue per trip, net operating income, operating ratio (Capital productivity) and catch per crew per trip (Labour productivity).

- Cost and earning profile of the selected ten craft -gear combinations in Kerala has been worked out and the investment options have been compared. The lowest investment option in Kerala is found to be a thermocool-drift gillnet unit with an initial investment of Rs. 10,000/- getting an average catch of about 18 kg and earning an average gross revenue of Rs 320/trip during October-November 2007. Similarly, the highest investment option is a multi-day trawler with an average investment of Rs 24 lakhs, incurring an average operating expense of Rs 78,000/trip of five days duration with an average catch of 2400 kg fetching an average gross revenue of Rs 1.07 lakh with net income of about Rs 29,500/-.

The 'Multi-day trawler' : The highest investment option

- The average operating cost per trip of single day trawling was worked out to Rs. 4458/- at Visakhapatnam and Rs.3934/- at Kakinada landing centres. The gross revenue per trip was estimated as Rs.7222/- at Visakhapatnam and Rs. 6280/- at Kakinada, thus giving a net operating income of Rs.2764/- and Rs.2345/-, respectively.

- In SDF trawling, the capital productivity was marginally more efficient in Visakhapatnam with a lower operating ratio of 0.62 than at Kakinada (0.64). The labour productivity was also more efficient at Visakhapatnam (27kg/crew/trip) than at Kakinada (26kg).

- The capital productivity of SDF trawling was efficient in Tamil Nadu (0.62 operating ratio) than in Kerala (0.84). The labour productivity also was efficient in Tamil Nadu (96 kg/crew/trip) compared to Kerala **(**76 kg) in SDF trawling.

- The average operating cost per trip of a 2-5 days multi-day trawling was estimated as Rs.44,357/- at Visakhapatnam and Rs.28,617/- in Kakinada with the respective gross earnings of Rs.63,542 and Rs.48,708/- per trip in both these centres. The net operating income per trip of a 2-5 days MDF trawling was marginally higher in Kakinada at Rs. 20,091/- than at Visakhapatnam at Rs.19,185/-.

- In multi-day (MDF) trawling (2-5 days), the capital productivity was higher in Kakinada with a lower operating ration of 0.64 than at Visakhapatnam (0.70). The labour productivity was higher in Visakhapatnam (194kg/crew/trip) than in Kakinada (104kg/crew/trip)

- In fish marketing, women retail vendors with an Average Fixed Cost of Rs.1000, and operating expense of Rs.900 (Rs.750 + 150 transportation cost) per day have an annual cash flow of Rs. 2,88,000/- and earns an annual income of Rs.75,000/-.
- The estimated value of marine fish landings at primary level increased from Rs. 13,287 crores during 2006 to 14,721 crores during 2007. The value of fish at last sales increased from Rs. 22,236 crores during 2006 to Rs. 24,934 crores in 2007.

PROJECT CODE	**SEE / PMS / 01**
PROJECT TITLE	**A diagnostic study on dimensions, causes and ameliorative strategies of poverty and marginalisation among the marine fisherfolk of India**
SCIENTISTS	**C.Ramachandran,** R.Sathiadhas, V.P. Vipinkumar, Sheela Immanuel and P.S. Swathilekshmi
CENTRES	Cochin, Vishakhapatnam, Mangalore and Chennai

- The study locations were selected in Kerala, Tamil Nadu, Andhra Pradesh and Karnataka in discussion with stakeholders as well as officials of the Department of Fisheries in the respective maritime states. The data collection protocol including PRA was pre-tested in selected locations to find the reliability and validity.
- For the first phase, the locations selected for the study were Anjuthengu, Kotture, Ambalappuzha, Thankassery in southern Kerala; Kasaba and Koyippady in Northern Kerala; Alamthala, Tuticorin (Tamil Nadu), Bhimlipatanam (Andhra Pradesh), Dakshin Kannada (Karnataka). Data were collected using standardized interview schedules through local enumerators during second quarter covering a total sample of 1400. A comprehensive data base covering different parameters like demography, socio-economics, livelihood assets, consumption-expenditure pattern, behavioural variables like conservation orientation, deferred gratification, cosmopoliteness, etc, has been developed which can be used for diachronic studies later.
- Preliminary analysis has shown that there was no significant difference between the BPL and APL families across the study locations when monthly per capita consumption expenditure (MPCE) alone was taken into account. Though this may be interpreted as abatement in absolute poverty, the extent of relative poverty is to be further probed. This also indicates the need for viewing poverty as a multi dimensional variable.
- The problem analysis based on RBQ values revealed that declining catch (0.9012) was ranked as the major problem across the study locations followed by lack of government support (0.8178), exploitation by middlemen (0.6178) and threat of AIDS (0.5564).
- A case study was conducted in Alamthala village in Tamil Nadu to assess the socio-technological changes happened after the bench mark study period of 1982-83. The village has registered amazing socioeconomic transformation. The literacy rate of the village has increased from 28.7% in 1982 to 97.2%, the percentage of huts has reduced from 31% to 0.01 %, the average family income increased nine fold, resistance to family planning has reduced from 91% to 5% and the extent of motorization was 98%. There is perceptible shift in occupational pattern towards non-fishery related jobs.

Alamthala village has only two catamaran units now compared to 100% such units in 1982-83

FUNDING AGENCY	**ICAR Network Project**
PROJECT TITLE	**Impact assessment of fisheries research in India**
SCIENTISTS	**Ramachandran C.,** R. Sathiadhas and R Narayanakumar
CENTRE	Cochin

- A case study on the utilization of CMFRI research data base for decision making regarding the Monsoon trawl ban in Kerala was done as an impact candidate. An estimate could be made on the basis of investment in relation to total value of the landings as is being done elsewhere. For eg, OECD 2003 estimated the total cost of US fisheries management as $ 613.5 million which was estimated as 17% of value of the total fish landing. Out of this, 33% was spent exclusively on research services. Using the same logic it could be seen that the total annual research investment of CMFRI when compared to the value of total landings taken at primary level alone is hardly 0.21 % to 0.25 % during 2005-06 to 2006-07. The same value at last sale price ranges between 0.12 to 0.14%. If the total export of marine fish from the country alone is considered the research investment share is less than 0.5%.
- The research papers produced by CMFRI during 1991-2006 were evaluated and total impact rating (based on NAAS rating) was worked out. Large majority of publications happen to fall in the rating category of 3-5. The presence of publications in higher rating categories is comparatively less. But it is worth to note that about 38% of international publications find a place in the very high rating category of 8-9.

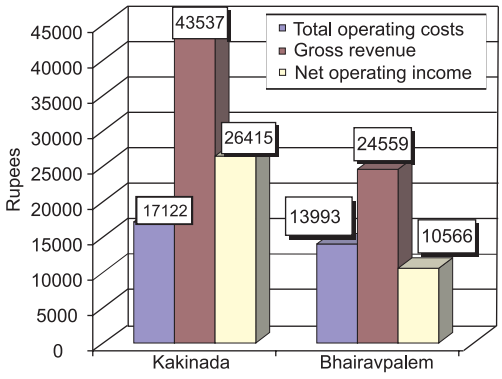
National and International publications of CMFRI across Impact factor (NAAS) categories during 1991-2006

Rating	National(n) (n=281)	Percentage	International(n) (n=48)	%
3.0-3.9	155	55.16	13	27.08
4.0-4.9	118	41.99	15	31.25
5.0-5.9				
6.0-6.9				
7.0-7.9	8	2.84	2	4.16
8.0-8.9			18	37.5

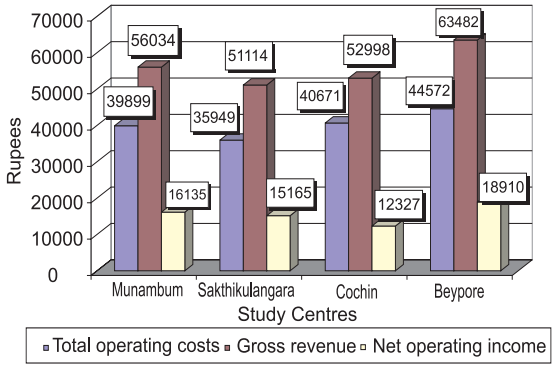
FUNDING AGENCY	**AP Cess Fund**
PROJECT TITLE	**Economic evaluation of trawl fishing in Andhra Pradesh and Kerala**
SCIENTISTS	**R.Narayanakumar** and R. Sathiadhas
CENTRES	Visakhapatanam and Cochin

- The economic performance of different methods of trawl fishing in Andhra Pradesh and Kerala was analyzed. The capital productivity ranged from 0.59 for Single day (SDF) trawling at Bhairavapalem to 0.73 at Visakhapatnam in Andhra Pradesh. In multi-day trawl fishing (MDF) (3-5 days), the capital productivity was most efficient at Kakinada with the lowest operating ratio of 0.49 among the four centres selected for the study in Andhra Pradesh.

- In Kerala, the capital productivity for SDF trawling was comparatively less efficient than at Andhra Pradesh with the operating ratios of 0.87 and 0.75 at Neendakara and Beypore respectively. In multi-day trawl fishing (MDF) (3-5 days), the capital productivity varied marginally among the selected centres namely Cochin Fisheries Harbour, Munambum, Neendakara and Beypore, which ranged from 0.62 to 0.64.
- The financial analysis of the different fishing units operating on single and multi-day fishing was carried out in both the States. The rate of return to capital ranged from 20.47 % at Visakhapatnam to 51.73% at Bhairavapalem for ringle day fishing in Andhra Pradesh. In Kerala, the rate of return to capital was higher at Beypore at 15.92% than Neendakara (9.58%) for SDF trawling. In case of MDF (3-5 days) trawling, the rate of return to capital ranged from 34% in Visakhapatnam to 56% at Kakinada in Andhra Pradesh while at Kerala, it ranged from 37% at Beypore to 44% at Neendakara.
- The Benefit-cost ratio ranged from 1.09 at Kakinada to 1.3 at Bhairavapalem for SDF trawl fishing in Andhra Pradesh, while the same ranged from 1.64 at Sakthikulangara to 1.60 in Beypore in Kerala. Since the ratio is more than one, the fishing operations are found to be financially feasible. In case of MDF (3-5 days**)** trawl fishing, the benefit cost ratio ranged from 1.20 in Kakinada to 1.35 at Visakhapatnam of Andhra Pradesh. In Kerala, the ratio ranged from 2.27 at Sakthikulangara to 2.43 at Cochin Fisheries Harbour.
- The technical efficiency of mechanized trawl fishing was worked out using the frontier production function approach. In Andhra Pradesh**,** the mean technical efficiency of SDF trawling worked out to 54 per cent and about 85 per cent of the fishing units were operating above the mean technical efficiency was of 54 per cent. In case of MDF trawling, the mean technical efficiency worked out to be 57 per cent, and 92 per cent of the fishing units were operating above the mean efficiency level.



Economic performance of multi-day trawlers (3-5 days) in Andhra Pradesh, 2006-07



Economic performance of multi-day trawlers (3-5 days) in Kerala, 2006-07

PROJECT CODE	**MBD/01**
PROJECT TITLE	**Understanding the threatened coral reef ecosystems of southern India and designing interventions aimed at their restoration**
SCIENTISTS	**Mary K. Manisseri,** Rani Mary George, V.S. Kakati, K.K. Joshi, K. Vinod, T. S. Naomi, Molly Varghese, S. Jasmine, N. K. Sanil, Miriam Paul Sreeram, Rekha J. Nair, Sujitha Thomas, Sandhya Sukumaran, K. S. Sobhana and P. S. Asha
CENTRES	Cochin, Vizhinjam, Mangalore, Karwar, Tuticorin and Mandapam

Soft coral, *Lobophytum crassum* from Palk Bay

- Underwater surveys were conducted at Palk Bay (July 2007), Tuticorin (September 2007, January 2008), Nethrani islands (October 2007, March 2008) and Vizhinjam/Enayam (October 2007, December 2007, January 2008).
- Line Intercept Transect method with GPS locations was adopted for the study of coral cover and health status. Underwater photography and videos were taken to assess the bioresources of the area. Water quality parameters were analysed.
- Bleached and dead corals were observed intermingling with the live corals. Acroporids, Favites and Porites were the dominant groups of hard corals in the Palk Bay.
- 13 species of hard corals were collected and identified from Enayam. The total coral cover area was about 83% with the bleached and dead corals forming only less than 1%. Enayam presented a generally healthy ecosystem.
- The total coral cover area at Vizhinjam was about 16%. Nine species of hard corals were recorded with Pocilloporids forming the dominant group.

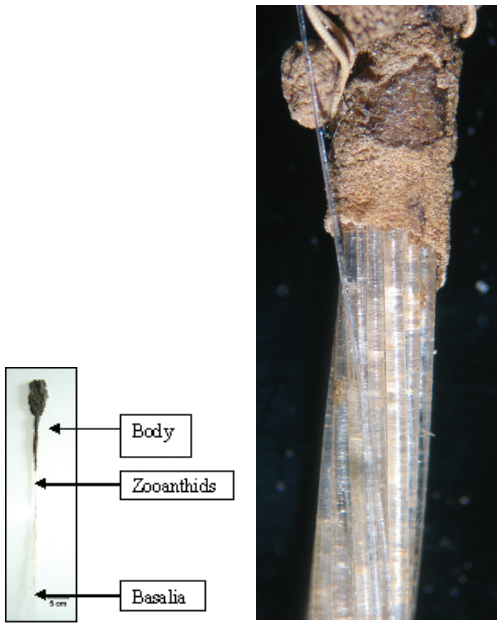
Diversity and status of hard corals at Vizhinjam and Enayam

Species	% cover	Life form categories	Relative abundance	Species status
Vizhinjam				
Pocillopora damicornis	1.75	Branching	10.79	Abundant
Pocillopora verrucosa	9.15	Branching	56.46	Dominant
Pocillopora meandrina	3.58	Branching	22.08	Dominant
Pocillopora woodjonesi	0.61	Branching	3.77	Common
Pocillopora eydouxi	0.12	Branching	0.73	Uncommon
Montipora millepora	0.44	Foliose	2.64	Common
Montipora aequituberculata	0.26	Foliose	1.62	Common
Montipora verrilli	0.17	Foliose	1.08	Common
Porites sp.	0.12	Encrusting	0.76	Uncommon
Enayam				
Pocillopora damicornis	1.04	Branching	1.25	Common
Pocillopora verrucosa	2.75	Branching	3.31	Common
Pocillopora meandrina	0.68	Branching	0.82	Uncommon
Pocillopora woodjonesi	1.71	Branching	2.05	Common

Pocillopora eydouxi	0.56	Branching	0.67	Uncommon
Montipora aequituberculata	66.98	Foliose	80.76	Dominant
Montipora verrilli	0.46	Foliose	0.56	Uncommon
Montipora hispida	0.23	Foliose	0.28	Uncommon
Montipora turgescens	0.23	Tabular/ plate	0.28	Uncommon
Acropora efflorescens	6.97	Tabular/ plate	8.4	Common
Porites lutea	0.74	Massive	0.89	Uncommon
Goniastrea pectinata	0.56	Encrusting	0.67	Uncommon
Turbinaria mesenterina	0.16	Laminar	0.19	Uncommon

White band disease in *Acropora* sp.

- *Vibrio alginolyticus* was the predominant bacterial species isolated from normal, bleached/diseased corals as well as from the sea water from the coral reef areas off Tuticorin. *V. alginolyticus* and *Pseudomonas* spp. were isolated from the bleached *Acropora intermedia*, while from the bleached *Acropora cytherea*, *V. alginolyticus* and *Vibrio harveyi* were isolated. The only disease observed was the 'white band disease' in *Acropora valenciennesi* collected from the New Harbour area, and the predominant bacterial species isolated was *V. alginolyticus*.
- A total of nine species of soft corals was recorded from Gulf of Mannar of which two species, *Sinularia mannarensis* and *Sarcophyton* sp. were not represented in the collections of the previous year.
- Sponges were found to be distributed in patches in the intertidal zone of Palk Bay. The mini trawls (locally called Thallumadi) landing at Mottagopuram fish landing centre, Tuticorin were found to remove large number of sponges from their natural habitat. The bottom set gill nets operated off Vellapatti were also found to remove sponges from their habitat, during their operation.
- The Hexactinellid sponge collected aboard FORV "*Sagar Sampada*" from Andaman waters (13°06' N lat. and 93°11' E long.) from a depth of 402 m was identified as *Hyalonema (Cyliconema) apertum apertum* (Class Hexactinellida, Order Amphidiscosida and Family Hyalonematidae). The body is spindle-shaped, followed by basalia in the form of long twisted spicules.
- Operation of '*Shinguvalai*' for lobsters was found to cause large-scale exploitation of molluscs and echinoderms from the coral beds in Palk Bay.
- Ten species of echinoderms and 76 species of molluscs were recorded from trawler discards at Rameswaram. Molluscan fauna contributed to 0.2% of the trawl landing at Rameswaram. Only dead specimens, encrusted with *Balanus* were available in the transect area in Palk Bay wherein *Turbo* spp. dominated.
- Six species of *Holothuria* were identified from different islands in Tuticorin, based on their morphology, spicule characteristics, radial and inter-radial plates.



Hyalonema (Cyliconema) apertum apertum Basalia in the form of twisted spicules

Pentaceraster mammilatus

Female *Sacura boulengeri*

- 65 species of marine ornamental fishes were identified and documented at Vizhinjam with the family Holocentridae dominating; whereas 17 species were documented at Enayam, with Lutjanidae as the dominant group.
- 50 species of coral reef fishes and 14 species of crabs were identified from different landing centres in Tuticorin and a database was prepared.
- 14 species of corals, 2 species each of crabs and lobsters, 12 species of molluscs and 92 species of coral fishes belonging to 36 families were identified from Nethrani Island, Karnataka.

World record of the rare female fairy basslet from the west coast of India

- Specimens of the rare fairy basslet, (Heemstra, 1973), known otherwise as 'Boulenger's anthias' belonging to the subfamily Anthiinae (Family Serranidae) were collected from trawler/boat seine landings off Neendakara, Mumbai and Mangalore.
- This is the third record of the occurrence of this species worldwide as the specimens were known previously only from the Gulf of Oman (05 nos.) and off Sindh, Pakistan (01 no.). The adult specimen of *Sacura boulengeri*, collected from the trawl catches off Neendakara forms the first female specimen recorded globally.

PROJECT CODE	**MBD/02**
PROJECT TITLE	**Studies on the specific and infraspecific diversity of Carangids of the Indian seas**
SCIENTISTS	**K.K. Joshi,** Rekha J.Nair, Miriam Paul Sreeram, V. S. Kakati, Sujitha Thomas, S. Jasmine, Molly Varghese and Sandhya Sukumaran
CENTRES	Tuticorin, Cochin, Karwar, Mangalore, Vizhinjam, Mandapam and Mumbai

Gnathanodon speciosus (TL: 42 cm)

Carangoides armatus (TL: 31 cm)

- Sixty-one species of fishes belonging to 20 genera of Carangidae were recorded. Maximum species diversity and abundance was reported from Tuticorin (57), Cochin (45), Mandapam (45), and less from Mumbai (15), Karwar (27) and Vizhinjam (26) coasts of India.
- Species diversity was more in the genera *Carangoides* (17) and *Caranx* (10) when compared to *Decapterus* (5), *Trachinotus* (5), *Alepes* (4), *Scomberoides* (4), *Uraspis* (3), *Alectis* (2), *Seriola* (2) *Atropus*. Genera like *Elagatis*, *Gnathonodon*, *Megalaspis*, *Naucrates*, *Parastromateus*, *Selar*, *Seriolina* and *Ulua* are monotypic.
- Species such as *Caranx ignobilis*, *Caranx melampygus*, *Caranx sexfasciatus*, *Gnathanodon speciosus*, *Carangoides armatus*, *Carangoides ferdau* and *Carangoides gymnostethus* showed infrapsecific variation and variation in colour patterns. Morphological changes were noticed as the fish grew to adult.
- Important species that contributed to the fishery from the juvenile stages were *Caranx ignobilis*, *Caranx melampygus*, *Caranx sexfasciatus*, *Caranx sem*, *Gnathanodon speciosus*, *Elagatis bipinnulata*, *Decapterus russelli*, *Scomberoidescommersonianus*, *Trachinotus blochii*, *Alectis indicus*, *Alectis ciliaris*, *Alepes melanoptera*, *Atule mate*, *Carangoides armatus*, *Carangoides ferdau*, *Carangoides gymnostethus* and *Selaroides leptolepis*.

PROJECT CODE	**MD/IDP/01**
PROJECT TITLE	**Technology development for seed production of shellfish**
SCIENTISTS	**K. R. Manmadhan Nair,** V. Kripa, Reeta Jayasankar, K. K. Vijayan, Josileen Jose, E. V. Radhakrishnan, Shoji Joseph, P. Muthiah, T. S. Velayudhan, I. Jagadis, Joe Kizhakudan, D. Kandasami, Margaret Muthu Rathinam and P. Vijayagopal
CENTRES	Mandapam, Chennai, Calicut and Cochin

Seed production of shrimp *Penaeus semisulcatus*

A total of 336 female *Penaeus semisulcatus* spawned in the shrimp hatchery at Mandapam R.C, in 101 hatchery runs and obtained 26.6 million nauplii were obtained. An estimated 16.4 million PL were produced at an average survival rate of 61.5%. The post larvae were sea ranched in the Gulf of Mannar.

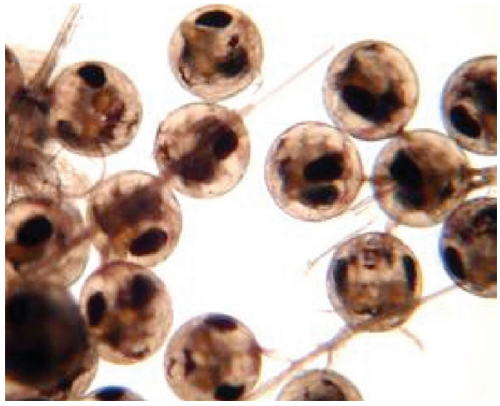
Seed production of marine crab *Portunus pelagicus*

About 71.3 million zoeae were produced from 155 berried female crabs. Almost the entire zoeae, except for the few lakhs used in larval rearing experiments, were sea ranched. In 73 larval rearing experiments 8355 baby crabs were produced. The survival from zoeae to baby crabs ranged between 0.09% to 11.12%. It was observed in rematuration experiments that the crabs fed *ad libitum*, daily on sardine and clams in 1:1 proportion, gave better results in terms of mating, spawning, berry formation and hatching.

Broodstock of *C. feriatus*

Spawning, hatching and larval rearing of *Charybdis feriatus*

C. feriaitus was spawned and hatched in captive condition. The egg mass weight varied between 16-32.5 g. The embryonic development was completed between 9 and 11 days. Completed the zoeal phase within a period of 22-26 days. The larvae pass through 6 zoeal stages (Zoea - 1 to Zoea -VI) and one megalopa stage.



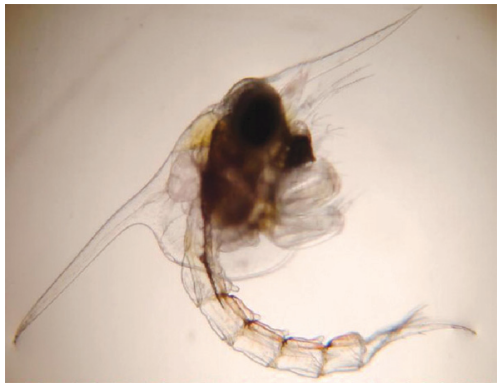
Developing eggs of *C. feriatus*

Lobster maturation and larval rearing

Three experiments on larval rearing of *T. orientalis* were completed using ctenophores and clam meat. Seed formation was achieved in all three cycles with survival rates of 10, 40 and 16. Mass larval rearing of *T. orientalis* with a transition from small chambers to 100 l aquaria gave good results.

Hatchery raised seed of *T. orientalis* reared (over a period of 340 days from larval hatching) in recirculatory system with *in situ* sandy substrate matured, mated and spawned in captivity without any external interventions. Unilateral eyestalk ablation in late juveniles and sub-adults was found to improve growth rate by 10-15%.

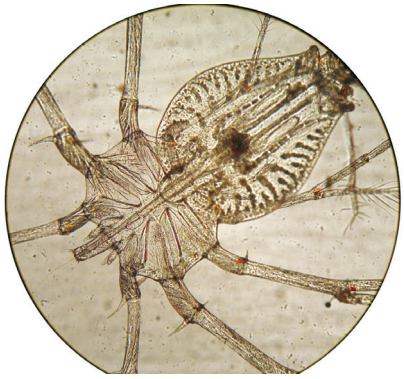
The use of enriched *Artemia* as a larval diet was found to increase consumption rate and survival in early *P. homarus* larvae. Larvae completed 8th stage on the 54th day.



Zoea of *C. feriatus*

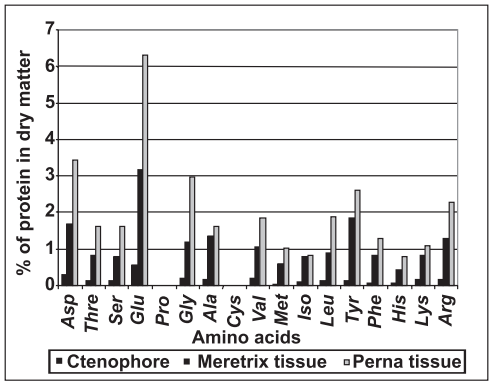
P. ornatus juveniles collected from the wild have matured in captivity. Pellet feed diets have been developed for broodstock of spiny lobsters *P. ornatus*, *P. versicolor* and *P. polyphagus*. Experiments using these diets along with live clam show promising results.

The amino acid and fatty acid profiles of different tissues of the *T. orientalis* and *P. homarus* and of different live/fresh feeds and feed



Advanced phyllosoma of *P.homarus* (magnified)

Hatchery raised seed of *T.orientalis* grown in the lab.



Amino acid and fatty acid profiles of feed used or lobsters

ingredients were studied to identify the optimum nutrient requirements for feed formulation and live feed enrichment for broodstock development, fattening and larval rearing.

Mussel seed collection from natural bed at Calicut

Attempts were made to develop seed collection methods for mussel seed by placing spat collectors. Bundle of 8 to 10 wooden sticks of 0.75 m length and 5 cm width were tied together and suspended from the spat collection units. Moderate settle of 450 nos per stick were obtained at South beach, Calicut.

A raft moored near Elathur exclusively for seed collection was maintained till June. However, only sparse seed settlement was obtained during this period.

Occurrence of bivalve larvae in plankton samples at Calicut was studied from April to October. Bivalve larvae were at a density of 3 per ml during April and increased to 15 and 48 per ml in the following two months. Sample could not be collected due to rough sea in July. During August and September the density was 14 and 21, respectively.

Breeding of clams, oyster and scallops

- Broodstock of the clams *Paphia malabarica* and *Marcia opima* were maintained at Tuticorin Research Centre. But heavy mortality occurred due to water pollution in the Bay.
- The oyster *Crassostrea madrasensis* was induced to spawn twice in the hatchery. The larvae developed till the umbo stage.
- Broodstock of the scallop *Amussium* sp. were collected from the coastal area near Tuticorin and maintained for conditioning. Scallops were found to be highly susceptible to desiccation and even three hours of exposure during transport was lethal.

Pearl Oyster

- Spawning obtained conducted during September, November & December'07 yielded 25,000 spats of 5.0 mm and were transplanted for further rearing.
- Pollution in the Karapad Bay resulted in mass mortality of brooders and spats. Inspite of this, about 25,000 spats of 2-3 mm are being reared in the hatchery for transplantation to farm.
- Conditioning of brood oysters are being carried out for attempting further spawning experiments.

PROJECT CODE	**MD/IDP/02**
PROJECT TITLE	**Development of diversified mariculture systems**
SCIENTISTS	**V.Kripa,** K. R. Manmadhan Nair, Gulshad Mohamed, P.K.Asokan, K.S. Mohamed, P.Muthiah, T.S. Velayudhan, I. Jagadis, G. Syda Rao, Joe Kizhakudan, Shoji Joseph, Anil M.K and Josilyn Jose
CENTRES	Cochin, Calicut, Veraval, Mandapam, Tuticorin and Vishakapatnam

MOLLUSCAN MARICULTURE

Mussel Farming

- The farmed mussel production in the country was estimated as 7894t during the period 2006-07, which is 2166 t lower than that of the previous year.
- An increase in the number of open sea farms (8 farms) was observed.

Details on the regional production of farmed mussel in Kerala during the period 2005-06 and 2006-07

	Rack 2005-06	Rack 2006-07	On-bottom 2005-06	On-bottom 2006-07	Total 2005-06	Total 2006-07
Kasargod	7496	5845	0	0	7496	5845
Kozhikode	211	95	511	623	722	718
Kannur	0	0	825	883	825	883
Malappuram	399	24	558	346	957	370
Thrissur	5	8	0	0	5	8
Ernakulam	25	40	0	2	25	42
Kollam	4	26	26	2	30	28
Total	**8140**	**6038**	**1920**	**1856**	**10060**	**7894**

Estimation of carrying capacity of bivalve farming area

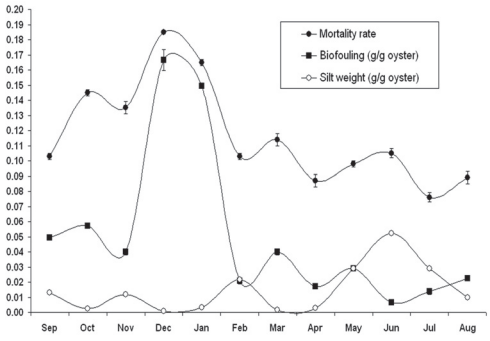
- The carrying capacity of Sattar Island in central Kerala with respect to mussel farming was estimated using standard methods. Some of the inputs used are tidal volume (3.2×10^5 m^3); mean tidal height (0.7m); POM levels, mean filtration rate; food supply and demand.
- The carrying capacity was estimated as 52 t and currently 12 farms produce nearly 24 t of mussel annually from this area. There is scope to double the number of farms in Sattar Island without adversely affecting the environment.

Oyster Farming

- Farmed oyster production in the country was estimated as 2150 t, higher than the previous years production of 1500 t.

Impact of oyster farming on village economy

- The oyster production during the period 2005-06 was estimated as 1500 t worth Rs. 7.1 million (119 t of oyster meat; @ Rs 60 per kg of meat) from an area of 1.71 ha. The average productivity has been estimated as 70 kg shell-on oyster per square meter.
- As a direct outcome of this industry, wooden poles valued at Rs 15.7 lakhs (30345 nos.) have been used. However, this has a durability of two to three years.
- Nylon rope valued at Rs.3.6 lakhs (2975 kg) and empty oyster shell worth Rs 1.5 lakhs (1487500 nos.) have also been used. Nylon rope and oyster shells were used for only one crop.



Variations in the monthly mortality rates, biofouling and silt weights on pearl oysters in Kollam Bay

- Additional labour was also generated for oyster farming. It was estimated that 1487 labour days (worth Rs 1.94 lakhs) were created for making ren and 1252 days (worth Rs. 17.85 lakhs) for heat shucking of oysters. These were carried out mostly by the family members or members of the Self Help Group and hence can be considered as family labour or group labour.
- For construction of farms 1190 labour days (worth Rs 2.975 lakhs) have been expended.

Impact of oyster farming on sedimentation near farm sites

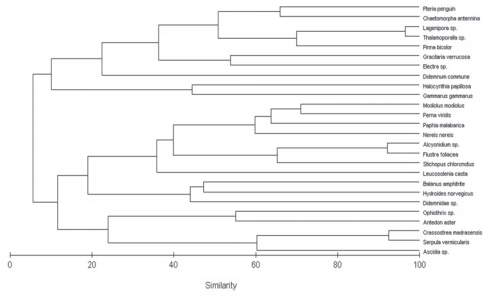
- It was estimated that rate of siltation was 15.8 g per day when oysters of length 60 to 80 mm were stocked in the farm and the normal siltation was 7.8 g per day indicating an increase of 2.08 times that of normal siltation rates.

Pearl Culture

- At Tuticorin the spat reared in the raft grew to an average size of 53.5mm after a period of 14 months indicating a growth rate of 4.0mm
- A total of 1500 pearl oysters were nucleated with 4-5 mm nucleus and these are reared in the farm.
- Quantitative analysis of protein was done in the in the nacre layer, mantle tissue with pallial organs, mantle tissue without pallial organs, body fluid and cell suspension from the in-vitro culture of *Pinctada fucata*. It was found that 1.18, 10.01, 10.31, 0.88 and 2.62% of protein were present in the respective components.

Seasonal fouling pressure on the farmed pearl oyster *Pinctada fucata* at Kollam Bay

- The average monthly total fouling weight on *P.fucata* was estimated as 0.066 ± 0.002 g per g oyster weight while the average monthly biofouling and siltation weights were estimated as 0.05±0.002 and 0.015 ±0.001 g per g oyster weight respectively in the pearl farm at Kollam
- The average total fouling weight and biofouling were highest during December, 0.1673± 0.002 and 0.166± 0.007 g per g respectively. In January also the biofouling rates were comparatively high and minor peaks were observed during March, May and October.
- Siltation was lowest, 0.0007 ± 0.002 g per g oyster during December and was negligible during October and March-April.
- Mortality rates were high during December and January when the fouling rates were also high and showed minor peaks during October, March and June.
- The average monthly mortality rate was estimated as 0.117 ± 0.002 and the monthly variations were significantly different ($P<0.01$).
- The fouling communities on pearl oysters were found to be composed of 25 species belonging to nine Phyla which showed variation in settling pattern.
- Urochordata (4 species) was the dominant Phyla which formed 26.6% of the average annual fouling followed by Annelida (18.7%), Rhodophyta (15.3%), Mollusca (14.1%) and Bryozoa (10.3%). Minor foulers were Porifera (6.2%), Arthropoda (5.5%), Echinodermata (1.8%) and Chlorophyta (1.5%).



Dendrogram showing species-wise clusters in the fouling community on the pearl oysters at Kollam Bay

- The ascidian *Didemnidae* sp. was the most prolific fouler with an average monthly fouling biomass of 4.57 ± 6.97 g per g of oysters followed by the seaweed *G. verrucosa* 2.930 ± 5.965, the calcareous polychaete, *Hydroides norvegicus* 2.824 ± 4.732, the bryozoans *Electra* sp. 1.228 ± 2.668 and *Leucosolenia* sp. 1.190 ± 2.397 and the striped barnacle *Balanus amphitrite* 1.052 ± 1.492.

Clam Culture

- **Clam semi-culture using Clam Tents :** Clam tents were designed and fabricated for farming of clam *Paphia malabarica* in Ashtamudi Lake. Results showed that a stocking density of 1.5 kg/m^2 was better for growth and survival (4 mm DVM growth and 2.2 times weight gain).
- *Paphia malabarica* of average size 14.8 mm were reared in a pen and they attained a mean size of 23.3mm with maximum length of 39 mm. In the 4th month, the mean size was 28.2 mm and the growth rate was 2mm per month.

CAGE CULTURE

Design and fabrication of integrated cage–pen-rack farms

- An integrated farm was set up for farming of mussels and finfishes. On the raft, seeded mussel ropes were suspended and in the cage seed of *Lutjanus* and *Etroplus* were stocked. The cages were made user friendly by providing inlets for feeding and stocking.
- The fishers collected juveniles of fishes, stocked them in the cage and their family looked after the daily feeding schedule. By this method, capture-based aquaculture was promoted and the new farm structure was tested.

A view of the cage moored at Vizhinjam Bay

Cage culture of finfish in Vizhinjam Bay

- Seed availability of *Siganus javus* was studied at Vizhinjam Bay using baited cages and drag net. *Siganus* juveniles were available during the month May to August with peak during the month of May. During May seed sizes ranged from 6.5 to 12. 4 wth an average of 8.4 cm in total length. Their availability was low during September to December. Juveniles of *S. javus* of the size 4-5 cm size were available during the month of January-February.
- Availability of carangid *Caranx sexfasciatus* was studied from the catches of shore seine. During the month of July size of *C. sexfasciatus* specimens ranged from 110 mm to 137 mm in total length, in August they ranged from 155 to 160 mm and during September their sizes ranged from 57- 68 mm. Their availability was low during the months of November to February
- A cage culture unit was launched in Vizhinam Bay on 22nd October 2007. The cage was of 3 m diameter and 4 m depth which was floated with help of a wooden raft. The cage was stocked with juveniles of *Caranx sexfasciatus* of average size 81.7 mm (TL) and 7.8 g weight caught using shore seine. Within four month they have grown to an average size of 210 mm (186 g).

Development of recirculation system

- A rearing system was developed for the short term maintenance of carangid juveniles collected for culture. The unit consisted of a 5 t

tank with two *in situ* biological filters and two overhead biological filtration units to which seawater is pumped using a submersible pump. The system was stocked with juveniles of *C. sexfasciatus.* They showed fast growth from 121 mm to 165 in 60 days.

SEAWEED CULTURE

- *Kappaphycus alvarezii* was farmed on bamboo rafts of 3.5 x 5 m size and 500 kg seed material increased to 1490 kg in 50 days indicating 3.1 fold increase.
- Onshore culture of *K. alvarezii* with baby crabs was not successful, within a week the plants degerated due to contamination and formation of blooms.
- Initial result of the experiment on integrated culture of *K.alverazii* with shrimp larvae in earthen ponds of CMFRI in Palk Bay was encouraging.
- Farmers adopting integrated farming of seaweed (*Enteromorpha intestinalis*) and *P.monodon* at Vypeen island got very good growth of shrimp for last two consecutive years without any viral disease.
- **Monoculture of *Hypnea valentiae* was carried out at Navibunder, Gujarat.** Seed material of *Hypnea valentiae* collected from the intertidal areas of Diu (Union Territory) were acclimatized in the tanks at CMFRI, Veraval. A two-meter square raft was constructed using bamboo pole and vegetative fragments of the plants with known weight placed in the 2 mm nylon hooks, which was inserted in the 3 mm nylon rope that tied to the bamboo poles. Ten nylon ropes with 100 gm seed material in each rope was introduced in the raft in the less saline waters of Navibunder in the post-monsoon periods.

Harvested sand lobsters

- A maximum of 5.2 fold increase in yield in 50 days was obtained during post-monsoon period of December and January by adopting raft culture method**.**
- **Monoculture of *Hypnea musciformis* was carried out at Chorwad, Gujarat.** Two experimental farming trials of *Hypnea musciformis* was carried out in the intertidal rocky areas by fixed bottom nylon rope method. A maximum of 6.2 fold increase in yield in 61 days during post-monsoon periods of January and February was observed.

CRUSTACEAN CULTURE

High density grow out of sand lobsters

- A semi-enclosed intensive system with substrate bed trickling filter, for high density growout of the sand lobster *Thenus orientalis* was successfully developed and tested at the Kovalam Field Laboratory. Cement tanks of 12.5 m^2 floor space and 0.5 m depth were used
- *T. orientalis* seed of 20 mm CL, 40 mm TL and 5 g approx weight were stocked in two tanks. The seeds stocked were nearly 70-80 days old and part of the stock was supplied from the hatchery while the rest was collected from the wild. The growout period was 250

days. The stocking densities were as high as 30 (tank I) and 35 (tank II) per m^2.

- The production was 2.5-3 kg per m^2 (equivalent to 20-30 t per ha) with a survival rate of 90-91%. More than 60% of the lobsters harvested had attained commercial marketable size.
- The growth rates and the cumulative period point indicate the fact that the species can be raised to commercial sizes in less than a year, from the seed production stage.

Polyculture of sand lobsters with shrimp

- In one high density growout tank, seed of the white shrimp *Penaeus indicus* (35-40 mm TL; 0.3-0.4 g) was stocked @35 per m^2 towards the completion of the lobster growout stage (70 days prior to harvest). At the time of harvest, more than 98% survival was recorded in the shrimp stock.
- The final lobster biomass harvested was 3 – 4 kg per m^2. The shrimp biomass harvested was 280 g per m^2 (average weight of each shrimp being about 8 g).
- The results obtained establish the candidature of *T. orientalis* for aquaculture as the species is relatively fast growing, not aggressive (placid) or cannibalistic, hardy, compatible for polyculture with shrimp and amenable to growing in highly intensive systems like raceways.

PROJECT CODE	**MD/IDP/03**
PROJECT TITLE	**Development of broodstock, captive breeding and seed production techniques for selected marine foodfishes and ornamental fishes**
SCIENTISTS	**G. Gopakumar,** L. Krishnan, R. Paul Raj, P.C. Thomas, K.C. George, Reeta Jayasankar, K. Madhu, K.K. Vijayan, K.S. Sobhana, Rema Madhu, Boby Ignatius, Kajal Chakraborthy, P. Vijayagopal, M.K. Anil and D. Noble
CENTRES	Mandapam Camp, Vizhinjam and Cochin

Broodstock Development and breeding of foodfishes:

A. Mandapam:

- Broodstock development of four species of foodfishes was being carried out at Mandapam Regional Centre during the period.

1. *Rachycentron canadum* (Cobia)
2. *Epinephelus malabaricus* (Grouper)
3. *Epinephelus polyphekadion* (Grouper)
4. *Trachinotus blotchi* (Pompano)

Rachycentron canadum (Cobia)

- Aquaculture of Cobia has gained momentum worldwide, after its successful commercial production in Taiwan. Fast growth rate, adaptability to captive breeding, lower cost of production, good meat quality and high market demand especially for the Sashimi industries are some of the attributes of these species that makes it an excellent

Broodstock of cobia

aquaculture species. It is also recognized as one of the suitable species for cage farming. Under the culture conditions cobia can reach 3 – 4 kg in body weight in one year and 8 – 10 kg in two years.

Water quality management in broodstock tanks:

- Filtered seawater upto three-fourth of the tank capacity was filled and good aeration was provided.
- Excess feed and wastes were removed from the tank bottom daily. 30% to 50 % sand filtered seawater was exchanged on alternate days. Cleaner wrasses were introduced to check the external parasites. The range of water quality parameters in the broodstock tanks were as follows:

Temperature	:	27 – 29°C
pH	:	8 – 8.4
Salinity	:	30 – 34 ppt
Ammonia	:	Below 0.1 ppm

Feeding

- Fishes were fed once in a day with small sardines @ 5% of their body weight.

Mortality of the fish:

- On two occasions, 100 % mortality occurred with larger broodstock fishes. In the first case, when feeding was done *ad libitum* with sardines, regurgitation was noted. Afterwards the fishes stopped feeding, became weaker, and swam near the surface with slanting movements. Then mortality followed. When dead fishes were examined, heavy infestation with parasitic copepods in body and gill was noted. On the second occasion also, mortality occurred in larger fishes. The symptoms were same as noted during the first occasion. In both the occasions, it appears that fishes were over fed on the previous day of observing the disease symptoms. However, the exact reason for mortality could not be ascertained.

Maturity studies on Cobia:

- Data on 21 fishes were collected. The total length ranged from 520 to 1240 mm and weight ranged from 0.9 to 13 kg. The size at maturity was around 900 mm weighing around 5 kg. The sex ratio is male: female = 1:3.

***E. malabaricus* (Grouper):**

- 8 numbers of broodstock fish stocked in 100 t capacity concrete tank. Length ranged from 51 to 65 cm and weight ranged 2 -3 kg. Feeding and water quality management were same as followed for cobia.

***E. polyphekadion* (Grouper):**

- 14 nos of broodstock fish stocked in 50 ton capacity concrete tank. Length range from 51 cm to 65 cm and weight range from 2-3 kg. Feeding and water quality management were same as followed for cobia.

Quarantine protocol developed

Fishes caught from commercial hooks and line fishing were brought to shore alive by taking special care and transported to hatchery in anaesthetized sea water (5 ml Aqui-S in 500 litres of seawater). Fishes brought to the hatchery were treated with 100 ppm formalin for one hour and kept in 5 tonne FRP tanks with filtered seawater for one day and stocked in outdoor concrete broodstock tanks.

Courtship behaviour of *E. malabaricus*

Raft for the multi-cage unit

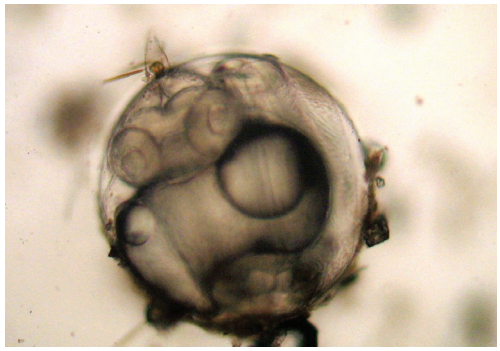
B. Vizhinjam:

Brood stock development and breeding of *Epinephelus malabaricus*

Rearing tanks size	:	10 tonne capacity
Biological filtration	:	Three biological filters each of capacity 100 lit.
Feed given	:	sardines, carangids, squids, prawns- *ad libitum*
Feed supplements	:	Vitamins and fish oil capsules
Number of brood stock fishes developed	:	15 fishes of size 4-8 kg
Hormone used	:	17α-Methyltestosterone

Spawning through environmental manipulations

- They showed courtship behavior especially during days close to full moon and new moon days but did not spawn.
- A new raft was launched for rearing wild caught brood stock at sea. The raft which of size 20 x 16 feet is made of *Ayani* wood. Raft contains a watchman's shed and space for attaching 6 net cages.

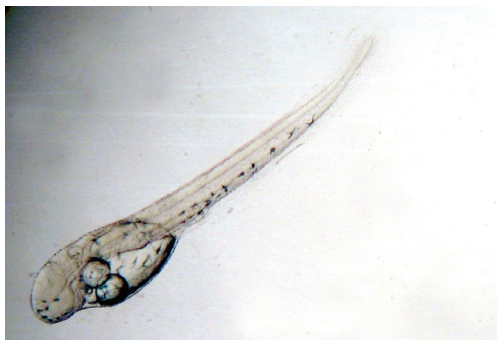


Egg of Rabbitfish in the process of hatching

C. Cochin:

Rabbitfish –*Siganus canaliculatus*

- The broodstock of rabbitfish were reared in 5 t FRP tanks with biological filters. The fishes were healthy and all fishes grew to size of above 500 g. These fishes were fed with green vegetables, seaweeds, prawn, fish meat and mussels. During November/ December, all fishes were in running stage, milt was freely oozing out from males while being caught using a scoop net.
- Natural spawning of rabbitfish occurred in the broodstock tank kept in the marine hatchery during February. These fishes spawned for the 3rd consecutive year during its spawning season. It indicated that the management of broodstock in 5 t FRP tanks is sufficient to keep fishes maturing and spawning. We were successful in collecting the fertilized eggs and making measurements. The eggs were collected and reared separately in 1 t FRP tanks adopting greenwater technique of larval rearing. The hatching of the larvae was good and all larvae were healthy and swimming. But after 5th day, all the larvae died. Insufficient feed (both microalgae and rotifers) was the reason for failure in the larval rearing.
- Intramuscular injections of LHRHa @ of 50µg/kg of body weight were given to two rabbitfish during non-spawning season. No spawning response was exhibited by these fishes.



Larvae of rabbitfish immediately after hatching

Broodstock development and seed production of ornamental fishes

- Broodstock development and breeding of the sapphire devil *Chrysiptera cyanae* was achieved.

Studies on larviculture of damselfishes

- The impact of greenwater and live feeds (copepods) on the larviculture of the *Dascyllus trimaculatus* (Three spot damsel), *D. aruanus* (Humbug damsel) and *Pomacentrus caeruleus* (Blue damsel) were studied.

Broodstock of *C.cyaneae*

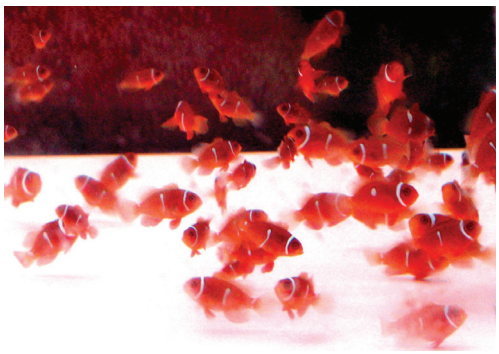
- The three species of damselfishes studied were with altritial type of larvae and the mouth gape of newly hatched larva ranged from 150 – 200 µ. Trials on feeding with the available strain of the rotifer *Brachionus rotundiformis* as starter feed were not successful. The co-culturing of the selected two species of copepods *viz. Pseudodiaptomus serricaudatus* and *Euterpina acutifrons* in greenwater along with larvae yielded positive results. The small size of the first naupliar stages of the copepods employed and the availability of different sizes of nauplii during the initial phase of larviculture had initiated and sustained the first exogenous feeding of the larvae. The initial stages of nauplii noted in the larviculture system measured from 60 – 80 µ, which is suited for the first feeding of the larvae.
- A microalgal cell count range 1 - 6 x 10^5 cells per ml was the optimum for multiplication of copepods as was indicated by the maximum number of egg bearing copepods and nauplii. The larviculture systems experimented with copepods and rotifers together as live feeds were not successful. The rotifers multiplied rapidly by parthenogenesis and filled the system. The copepods being sexually reproducing could not keep pace with the rotifer multiplication and were eliminated from the system. The larvae of the species experimented were unable to accept rotifers as starter feed which resulted in total mortality of the larvae. It was also noted that the critical phase of larviculture was over by 15 – 20 dph. After 15-20 dph, the mouth gape had reached around 450µ and can be fed with freshly hatched *Artemia* nauplii. The absence of any mortality from this stage onwards indicated that once the starter feed problem is solved, the larviculture of these species could be accomplished easily with conventional live feeds.

Standardization of broodstock development and breeding techniques for Maroon clown *Premnas biaculeatus*

- Broodstock development through pair formation experiments were standardized and through pair formation two pairs of broodstocks were developed. One pair was bred successfully and during the period, a total of 12 captive spawning were achieved.

Standardization of larval rearing of *Premnas biaculeatus*

- Compared to other clown fishes reared, it was found that larval rearing of *Premnas biaculeatus* was complicated. In the experiments, different combination of microalgae and rotifers (enriched and non enriched), *Artemia* (newly hatched and enriched) were tried. The larvae obtained from 22 captive spawnings were used for standardisation and developed a protocol.



Juveniles of *P. biaculeatus*

Standardization of juvenile rearing of *P.biaculeatus*

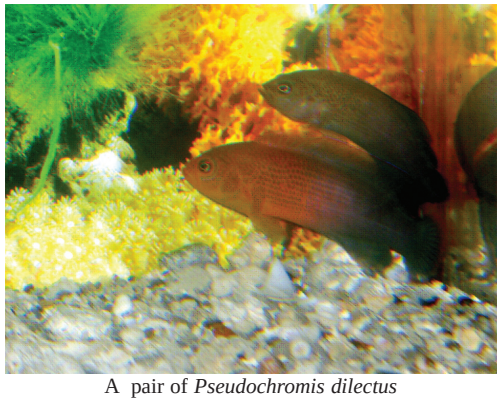
- Two experiments on juvenile rearing of *P.biaculeatus* were carried out. Experiments showed that culling of juveniles are essential to get maximum growth. To accelerate growth, the juveniles were culled to different groups. The juveniles produced were reared in indoor system and outdoor tank. Good survival was obtained in out-door rearing system.

Broodstock development and captive breeding of Redhead dottyback *Pseudochromis dilectus*

- The Redhead dottyback *Pseudochromis dilectus* was successfully bred under captive condition in the Marine Hatchery of C.M.F.R.I.

Cochin. This species is much valued for the aquarium trade as they are hardy, small, colourful, adapt quickly to the life in aquaria and compatible with other species. The species exhibits sexual dimorphism and males are reddish in colour whereas females are dark green. Conspicuous size variation is also noticed in the species with males being elongate, colourful (reddish) and slimmer and the adult females slightly smaller and plumper in the abdominal region.

- Different age groups of *Pseudochromis dilectus* (70 to 120 mm total length) were collected and experiments were conducted for pair formation. After 5 to 6 months rearing, pairs were formed. The developed pairs were fed with meat of prawn and adult Artemia daily.



A pair of *Pseudochromis dilectus*

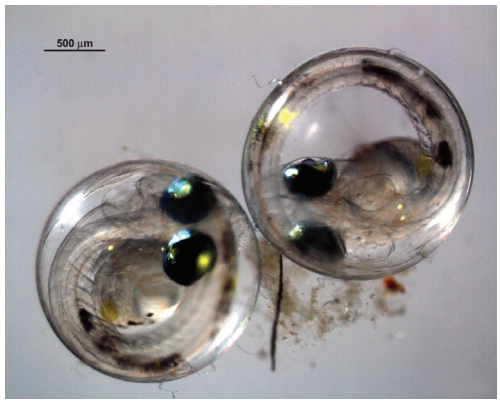
Spawning

- Few days prior to spawning, the male starts making a cave/burrow and an increased interaction was noticed. After a period of two months of broodstock development, the pair spawned. Successive spawnings were obtained every 6 to 15 days interval. Spawning usually occurs during the morning and lasted for one to two hours, during which the female gradually produces a ball-shaped egg mass while upside down in the burrow. The deposited spherical egg ball sank to the bottom of burrow.
- The diameter of the spherical egg ball varied between 25 to 35 mm and consisted of 400 to 500 spherical eggs. Size of the individual egg varied between 1743 to 1919 µ during incubation and all the eggs were interconnected by fine threads.
- The incubation period lasted for 96 hours at water temperature 27 to 28° C under hatchery condition. The egg bundles were white / transparent in colour on first and second day and subsequently black spot showing eyes of the larvae appeared on 3rd day, and on 4th day the silvery eyes were glittering.
- The hatching took place in the evening of the 4th day after spawning (96 h) and the newly hatched larvae measured to 5.1 to 5.3 mm total length.
- On the 14th day, the larvae had reached a pre-settlement stage with a total length of 10 mm. The larvae metamorphosed to juvenile stage between 30 to 35 days after hatch and settled to the bottom of the tank.

Male guarding the ball shaped egg mass in the burrow under the tiles

Live feed investigations

1. Few new strains of microalgae were isolated from Cochin and Poovar. It includes *Anabaena*, *Chlorella* from Poovar and *Chlorococcus*, *Navicula*, *Tetraselmis* from Cochin . Characterization of these species are in progress.
2. Rotifer, protozoa and copepod and nematodes were maintained in different microalgal feed.



Egg just before hatching showing fully developed embryo

Studies on copepods as live feed for larviculture

- Two species of harpacticoid copepods *viz*, *Longipedia weberi* and *Microsetella norvegica* were isolated and their biology was studied. The length range of adults of *L. weberi* was 550 to 945 microns and the early nauplii measured about 75 microns. The fecundity ranged from 15 to 18 eggs per batch. The nauplii became adult within 7 to 9 days and released first batch of young ones by 12 - 13th day. The

40 days old juvenile of *P. dilectus*

length range of *M. norvegica* adults was 277 to 540 microns and the early nauplii measured around 57 microns.

Biochemical studies on broodstock and larval nutrition

Larval nutrition

- Attractability, growth and survival of the larvae of Blue damsel (*Pomacentrus caeruleus*) and Yellow damsel (*Neopomacentrus nemurus*) were monitored after feeding rotifers enriched with Algamac 2000 @ 300-600 mg per million rotifers. Survival rates on 20 days post hatch (dph) was observed to be at par with that of feeding copepods. This is a significant intervention which will enable up scaling of hatchery technology of these fishes without dependence on copepod culture.

Broodstock nutrition

- Efforts to feed the wild caught animals with a wet soft pellet and a dry pellet soaked in seawater for softening were not successful. Even if one or two pellets are ingested these pellets are spat out immediately. Regurgitation of feed especially, lesser sardines could be also noticed in some of these fishes.
- Lesser sardines containing approximately 20% moisture is fed after removal of gut and head. This was also analysed for their fatty acid profile which is given below. On perusal of this data it is observed that the ratio of DHA: EPA: ARA is approximately 1: 2: <1. The ideal ratio reported for marine finfish is 2: 1: 1 which implies that other species of low quality fish which can used as feed for cobia has to be profiled for their fatty acid content and chosen as feed for maturation of these fishes in captivity.

Fatty acid analyses of egg and larvae of damselfish under two treatments (control and green water condition)

- An experiment to observe the effect of microalgae on the growth and biochemical profiles (with respect to fatty acid and hormones) of different larval stages of damselfish under captive condition was carried out.
- A higher content of DHA (65.28%) was observed in the 24 h egg. Among SFAs, the fatty acids 16:0 (17.86%) and 18:0 (7.03%) were prominent. Whereas among MUFAs, 16:1n7 was the only fatty acid present (6.15%). The total PUFA of the egg was found to be contributed by only DHA (65.28%), and no other fatty acid was detected. These results conclude that DHA is a very important component in the nutrition and accordingly larvae fed with DHA supplements will contribute to the growth and development of larvae. The 48h and 72-h egg of damselfish exhibited a reduced content of DHA with an increment of monoenoic and nonenoic fatty acids. The 48 and 72-h eggs had higher proportions of shorter carbon chain PUFAs (18:2n6, 18:3n3) together with lower amounts of C16 fatty acids. The highest levels of MUFAs were found in 72-h eggs (59.28% TFA.
- The sterols (precursors of growth hormones in larvae) in the larvae enriched with *N. occulata* (enriched for 48 h) were analyzed to be 17α-estradiol (Rt of 8.82) and estriol (Rt of 10.15). Under controlled condition, these sterols were found to be lower, whereas the β-isomer of estradiol was found to be higher than its α-counterpart. These results indicate that the microalgae plays a vital role in maintaining a balanced sterol titre in the larvae.

Fatty acid composition of lesser sardines fed to cobia broodstock (% wt. of total lipid)

Palmitic 16:00	13.09
Stearic 18:00	1.51
Oleic 18:1 n-9 trans	14.13
18:1 n-7	5.55
Linoleic 18:2 n-6 cis	16.00
18:2 n-6 trans	3.71
Linolenic18:3 n-3 cis	3.56
18:3 n-3 trans	3.06
ARA 20:4 n-6	0.81
EPA 20:5 n-3	18.68
DHA 22:6 n-3	7.63
DPA 22:5 n-3	1.65

Biochemical composition of foodfishes and the enrichment of essential PUFAs from oil by physicochemical and enzymatic procedures

Preparation of PUFA Concentrates from shark oil by physico-chemical procedures

- Different sources of polyunsaturated fatty acids (elasmobranchs) have been screened for essential fatty acid content. The oils from different sources have been characterized for essential PUFA content that revealed higher content of DHA (39% TFA in shark oil).
- PUFA concentrates (58.63% TFA) containing higher docosahexaenoic acid (DHA) content (39.15% TFA) was prepared from shark liver oil by alkaline hydrolysis (pH = 7.6) of triglycerides. DHA has been further concentrated from adipose tissue of shark by means of adsorption and amide complexation, and then further purifying the high-purified, concentrated PUFAs by means of argentated column chromatography in a high purity of >95%.
- The MUFAs were eluted with 5-10% diethyl ether in *n*-hexane, the major share was contributed by 16:1ω7 and 18:1ω9, whereas the PUFAs were found to elute with higher gradient (>30%) ether in hexane. The PUFAs were also eluted with other solvent systems (hexane in ethylacetate).

Enrichment of Eicosapentanoic acid concentrates from sardine oil by bacterial *(Bacillus circulans)* lipase isolated from seaweed *Turbinaraia* sp.

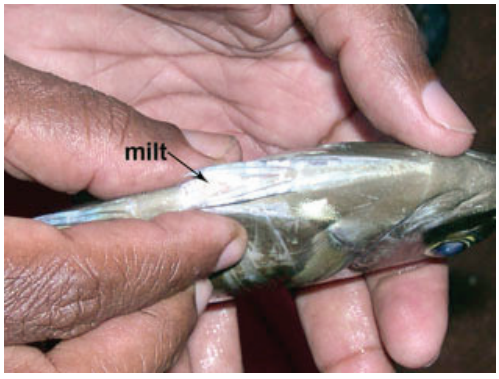
- An extra cellular lipase purified from *Bacillus circulans* from seaweed *Turbinaria* sp. was used to enrich EPA from sardine oil. The enzyme was purified 178.39-fold by a plurality of chromatographic techniques with a yield of 5.21% and a specific activity of 386.15 LU/mg.
- This lipase was able to enrich sardine oil with 37.74 ± 1.98% EPA after 3 h of hydrolysis of triglycerides. The purified lipase produced the highest degree of hydrolysis for SFAs (83.7%) followed by MUFAs (69.1%) and PUFAs from their initial content after 3 h. Lipase catalyzed hydrolysis of sardine oil for 3 hours followed by amide complexation provided free fatty acids containing 51.29% EPA.
- The individual fatty acids were determined as fatty acid methyl esters (FAME) by chromatography. Gas liquid chromatography of the EPA methyl ester revealed the single peak of eicosapentaenoic acid with a retention time of 9.34 ± 0.49 minute in a fast GC-mode (separation time 14.4 minutes). The results suggest that the lipase purified from *Bacillus circulans* may be a useful biocatalyst for concentrating EPA from marine fish oils.

Pathological studies

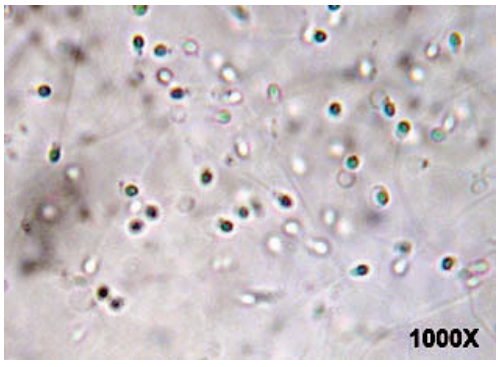
- A survey of histopathological lesions in the vital organs of grouper *Epinephelus tauvina* was carried out using wild specimens. Tissues of thymus, gill, liver, spleen, heart, kidney, skin, eyes and brain were examined. The gill, skin, liver and kidney had protozoan infections in all cases. These protozoa appeared similar in morphology to myxozoans. This finding is important as we are using these wild stocks for breeding purpose.

- The *E.merra* kept in the hatchery developed severe mortality. Autopsy examination revealed pale liver and pale gills. The histological examination of all vital organs revealed severe lesions in liver, kidney, spleen, heart, brain, gills and skin. The hepatic cells underwent necrosis, vacuolation and there was fibrosis around bile ducts. In hepatic parenchyma, there were several foci of protozoan multiplication. Protozoan was seen in cysts and bile ducts. In kidney, there was tubular necrosis and several foci of protozoan accumulation. Spleen also had foci of necrosis and areas of protozoan accumulation. Brain contained protozoan cysts and cells. The neurons underwent necrosis and degeneration. There was satellitosis and neuronophagia along with gliosis. The heart, gills and skin also had the protozoan infection. All these protozoans appeared indistinguishable from myxozoans.

- Broodstock of Cobia and rabbit fish were monitored for the presence of protozoan and metazoan parasites. Most of the broodstock when brought from the wild had showed the presence of crustacean parasite *Caligus* sp. and monogenetic trematodes. Once the animals were kept in captivity, the parasites multiplied in a fast pace, affecting the activity of the fish, especially the feed intake. On a couple of occasions, secondary bacterial infections later manifesting into septicaemia, and death were also observed. Considering these, a procedure for quarantine and prophylactic measures, especially for the control and avoidance of parasites and secondary bacterial infections are being developed, on a priority basis.



Milt collection



Spermatozoa

Genetic studies

- Assortative breeding programme for generating pedigreed foundation stocks of Blue damsels and Sebae clowns were initiated. The individuals were assigned to fifteen breeding compartments as pairs to mature, pair-mate and produce the pedigreed base generation consisting full-sib families for genetic evaluation and selective breeding.

Cryopreservation

- Milt was collected from Rabbit fish (Family: Siganidae) and studied the sperm quality and other characteristics affecting cryopreservation and fertility.

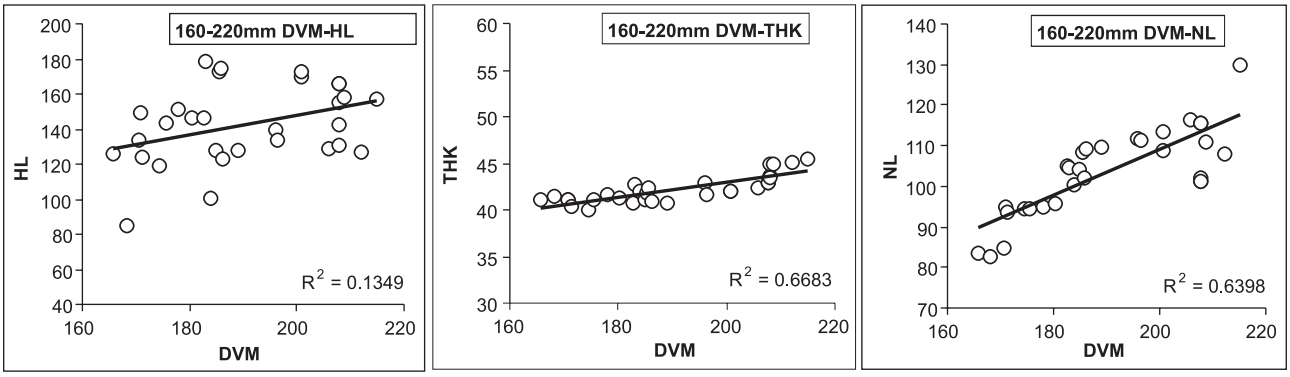
(i) Milt collection: Milt was collected from adult fish of average length 205 mm & weight 124 g (12 nos.) and ova from females of 199 mm length & 117 g weight (5 nos.) immediately after catching from the sea.

(ii) Sperm motility characteristics: Based on estimates of percentage of motile sperm cells and the swimming vigor, motility score corresponding to an arbitrary scale from 0- immotile to 5-100 percent motile was given. If the score was 4 it was fit for cryopreservation. Sperms were found to live upto 2 hours after death of the animal, though the motility score reduced considerably.

FUNDING AGENCY	**Ministry of Earth Sciences**
PROJECT TITLE	**Farming and pearl production in the Black lip pearl oyster *Pinctada margaritifera* in the Andaman and Nicobar Islands**
SCIENTISTS	**M. J. Modayil,** K.S. Mohamed, T.S. Velayudhan and V. Kripa
CENTRE	Port Blair

The following achievements were made during the year:

- Collected more than 500 oysters for broodstock development, nucleus implantation and studies on growth and fouling.
- Spat settlement was at maximum in December and January and fish net cages recorded the highest settlement.
- Environmental parameters were collected regularly from both Marine Hill and Havelock Island farms.
- Studied the growth and biometric relationships of *Pteria penguin*.
- The black-winged pearl oyster, *Pteria penguin* (Roding, 1798) is widely distributed in Indo-Pacific region and has prime importance in the production of mabe pearls or half pearls. In India, its natural occurrence is confined to the Andaman and Nicobar Islands. The biometric relationships between (Dorso-Ventral measurement [DVM] and Notch Length [NL]; Hinge Length [HL]; Thickness [THK] and Total Weight [TWT]) were studied from 155 oysters collected from these islands which were grouped in 3 length classes. In all size groups, there was increase in weight with increase in length. The highest coefficient (r^2=0.745) was obtained for the animals with DVM ranging from 100 to 160 mm. The correlation coefficient 'r' was low for DVM-HL and was higher for DVM-NL and DVM-THK.



FUNDING AGENCY	**Minsitry of Agriculture**
PROJECT TITLE	**Open Sea floating cage demonstration farm for R&D in marine finfish and shellfish production**
SCIENTISTS	**M.J. Modayil,** L. Krishnan, G. Syda Rao, G. Gopakumar, V.V. Singh and P.K. Asokan
CENTRES	Visakhapatnam, Mandapam, Veraval and Mumbai

- The cage net used was about 15m diameter and about 6m deep. It is protected by an outer predator net which prevent the large fish/ mammals from damaging the cage net. On the top of the cage railing, a bird net is provided to prevent the bird attacks. The entire net is kept in position by ballast and ropes tied to the mooring chains. The cage is provided with a shock absorber on the mooring chain to


Cage farmed seabass *Lates calcarifer*

withstand and absorb the pressure of winds, currents etc. The total volume of net in the water is about 850 cubic meters. It can hold up to 25 to 30 tonnes of live fish at a given time without any congestion. The cage was moored at a depth of 11 m about 300 m from the shore line on RK beach of Visakhapatnam.

- About 1350 fish seed of Asian seabass (*Lates calcarifer*) of 14.5 g acclimatized from zero ppt to 30ppt were stocked in the cage on 23rd December 2007 and from then all biological and environmental parameters were monitored. They were fed with low valued trash fish on a daily basis.
- After 125 days, about 550 kg seabass were harvested. The weight ranged from 300 g to 1200g. Majority were above 500g. About 10% were around 1 kg. The maximum recorded weight was 1200g with a length of 31 cm. The survival was 73%. Apart from the sea bass, 5 kg of tiger and brown shrimps of 25 count, 3 rock lobsters of 400 g each and other fish of 215 kg were harvested. The entire produce was handed over to IFP for product development.


Harvesting cage farmed *Lates calcarifer* off Visakhapatnam

PROJECT CODE	PNP/NUT/01
PROJECT TITLE	**Formulation and evaluation of larval and grow out feed for marine crabs, lobsters, ornamentals and cage farmed finfish**
SCIENTISTS	**P. Vijayagopal,** R. Paul Raj, D. Kanadsami, Imelda Joseph, I. Rajendran, Margaret Muthu Rathinam and Kajal Chakraborty
CENTRES	Mandapam, Cochin and Madras

Ornamental fish nutrition

- Two ornamental fish feeds developed at CMFRI were compared for their performance with two ornamental fish feeds procured from the market in *Amphiprion sebae* (the sebae clown).

Proximate composition and cost of ornamental fish feeds procured from the market and marine ornamental fish feeds formulated at CMFRI

Trade name	Aquadene	Tokyu	CMFRI OFF35	CMFRI OFF45
Country	Malaysia	Japan	India	India
CP	35	45	36	47
EE	5	6	5	5
CF	5	5	1	1
NFE	41	31	51	38
Ash	16	10	6	9
Cost INR kg^{-1}	500	300	190	210

CP= Crude protein, EE = Ether extract, CF = Crude fibre, NFE = Nitrogen free extract

Comparative nutritional performance of *Amphiprion sebae* for nine weeks

	AQ35	AD45	CMFRI OFF35	CMFRI OFF45
Initial weight mg	264.22	284.33	240.56	221.67
Initial length mm	24.00	23.83	22.22	22.17
Wt. Gain mg	461.28	452.92	514.69	514.08
Length gain mm	9.00	9.83	14.78	11.33
SGR % day^{-1}	1.60	1.51	1.82	1.90
CF	2.02	1.93	1.49	1.96
AGR mg day^{-1}	7.32	7.19	8.17	8.16
RGR %	174.58	159.29	213.96	231.92
Survival %	11.11	33.33	33.33	33.33

SGR – Specific growth rate, CF – Condition factor wt. mg/length mm^3
AGR – Absolute growth rate, RGR – Relative growth rate

- Proximate composition analysis showed that a feed with lower nutrient composition (Aquadene) is priced higher and feeds formulated and produced in-house costs less. Quantities of the feeds present in the containers were less than the quantity labeled in both the feeds procured from the market.
- Nutritional evaluation revealed superiority in the performance of the indigenously developed formulated feeds at CMFRI. These results suggest the possibility for the development and marketing of indigenously developed feed for marine ornamentals in India.

Ingredient composition of formulated feeds (g kg^{-1})

Ingredients	CMFRI OFF 35	CMFRI OFF 45
CIM[1]	380	580
Wheat flour[2]	510	310
Fish oil[3]	30	20
Vitamin Mixture[3]	20	20
Mineral mixture[4]	10	10
Vitamin C[5]	5	5
Lecithin[6]	5	5
Spirulina[7]	30	40
Mixed carotenoids[8]	10	10

[1]Common ingredient mixture – equal mixture of fish meal, shrimp meal, squid meal and soya flour [2] From the local grocery shop [3] Codliver oil [4] Sitto mix [5] Vitamin – C DSM Nutritional Products Asia Pacific Pte. Ltd. [6] Soy-lecithin from Hi-Media [7] Certified organic spirulina from Parrys Nutraceuitcals [8] Mixed carotenoids from Parrys Nutraceuticals

Crab and lobster nutrition

Formulated feed tested in *Portunus pelagicus* & *Panulirus homarus*

Ingredient composition	g kg^{-1}
Fish meal	300
Soy meal	336
Wheat gluten	200
Cod liver oil	20
Vitamin and mineral mixture	20
Edible oyster shell powder	20
Soy lecithin	62
Brick powder	20
Gelatin	20
Cholesterol	2

Initial	CW range (mm)	Weight range (g)
Males	36-67.5	5.3-23.9
Females	35-72	3.8-19.6
Final		
Males	79 – 110	25 - 82
Females	84 – 110	36 - 73

CL – carapace length, CW – carapace width

- In an experiment with the blue swimmer crab *Portunus pelagicus* of 60 days duration, the initial biomass was 0.83 kg and the final biomass was 3.43 kg. The increase in total biomass was 2.6 kg with a food conversion ration (FCR) of 1.9:1 and a survival rate of 60 percent.
- With the lobster *(Panulirus homarus)* in a high density lobster culture experiment (initial biomass 13.4 kg) and a stocking density of 12.5 kg $(m^{-1})^2$ with a culture duration of 170 days with a co-feeding regime of clam meat and formulated feed, cannibalism could be reduced significantly. For 5.5 kg increase in biomass over the initial, the FCR was 7.45.

Nutritional Biochemistry

- In order to find novel sources of polyunsaturated fatty acids (PUFA) from marine ecosystem, shark liver oil, ray liver oil and the phytoplankton *Nannochloropsis oculata* were profiled for their fatty acid composition. Shark liver oil contained 39 percent docosohexaenoic acid (DHA) of the total fatty acids, ray liver oil contained only 8.26% DHA and *N. oculata* contained a desirable ratio of PUFA, 17.5% DHA: 6.22% EPA (Eicosopentaenoic acid): 2.82% ARA (Arachidonic acid); indicating the potential use of mass cultured phytoplankton as a source of PUFA.

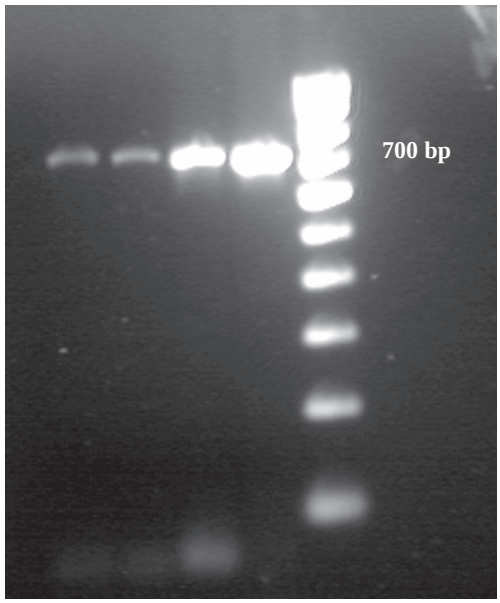
PROJECT CODE	**PNP/BIOT/02**
PROJECT TITLE	**Biotechnological applications in mariculture and conservation**
SCIENTISTS	**P.C. Thomas,** K. K. Vijayan, P. Jayasankar, K. S. Sobhana , U. Rajkumar, I. Rajendran and Kajal Chakraborty
CENTRES	Mandapam, Cochin and Madras

Molecular genetic profiling and development of biomarkers of commercially exploited endangered teleosts.

- Development of DNA barcode of marine catfish *Tachysurus maculatus* and *Tachysurus thalassinus*, an important fishery resource of Indian seas facing threat to its very existence due to over-exploitation and damage of eggs were initiated.
- Mitochondrial DNA sequence coding for the Cytochrome C oxydase subunit 1 (*cox1*) gene forms the primary barcode for unambiguous species identification. Hence the PCR amplification of *Cox-1* was optimised using the following two primer pairs specific for *Cox-1*.

F1- 5' TCA ACC AAC CAC AAA GAC ATT GGC AC 3'
F2- 5' TCG ACT AAT CAT AAA GAT ATC GGC AC 3'
R1- 5' TAG ACT TCT GGG TGG CCA AAG AAT CA 3'
R2- 5' ACT TCA GGG TGA CCG AAG AAT CAG AA 3'

- Primer combination of F1- R2 was found to amplify a 700 bp gene segment.The PCR amplified *Cox*-1 gene segments on sequencing revealed the nucleotide positions of a contiguous region of 435 bases out of the 700 bp segments that was amplified.
- The sequence data were aligned using BIOEDIT sequence alignment editor for estimating genetic homology and constructing phylogenetic tree (Neighbor Joining 'NJ' and Maximum Parsimony 'MP') using MEGA 3.1. Molecular genetic profiling of Marine catfish through arbitrary primed PCR amplification of genomic DNA was also carried out. From an array of arbitrary primers tested, three selected for generating AP- PCR pattern were OPBH-01, OPBH-02 and OPBH-03. A genus specific band of 900 bp size was found to be amplified by OPBH-01 which could be used as a genus diagnostic marker.



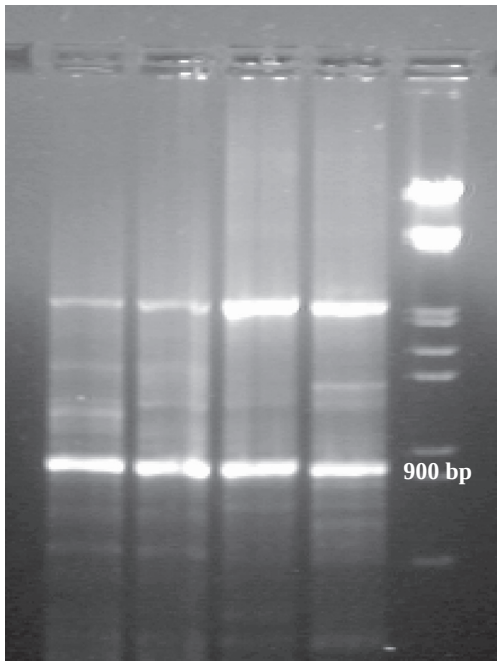
Cox-1 gene segment of catfish amplified by PCR

Molecular genetic profiling and comparative functional genomics of pearl oysters

- Arbitrary primed PCR amplification of *Pinctada fucata*, *P. sugilata* and *P. margaritifera* was optimized. PCR trials for standardization of functional gene amplification from pearl oysters are in progress. Comparative functional genomic analysis especially that of the nacre related gene, through PCR amplification using gene specific primers and relative quantitation analysis is envisaged.

Development of cell culture systems from *Epinepheles malabaricus*

- Seven successful cell culture systems have been developed from tissues such as heart, gill, spleen and caudal peduncle o the grouper, *E. malabaricus* and are being passaged for developing cell lines of the respective tissues. Details of the cell culture systems developed and the number of passages till date are given in the table.

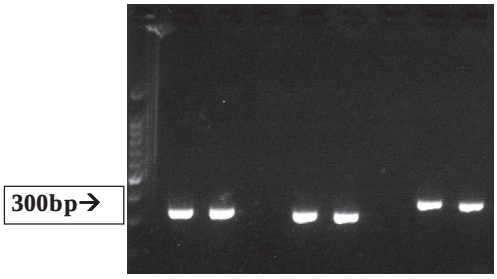


Genus specific band of catfish amplified using arbitrary primer OPBH-01

SLNo	Code	Tissue of origin	No. of passages
1.	EM2G Ex	Gill explant	24
2.	EM3G Ex (Fb)	Gill explant	22
3.	EM3G Ex (Ep)	Gill explant	22
4.	EM4Sp Ex	Spleen explant	14
5.	EM2Cp Ex	Caudal peduncle explant	13
6.	EM2H Ex	Heart explant	8
7.	EM2H Tr	Trypsinised heart tissue	7

Histopathological lesions in the vital organs of grouper *Epinepheles tauvina* collected from wild

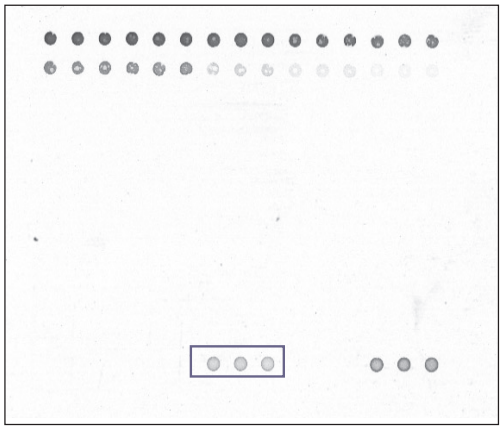
- The gill, skin, liver and kidney had protozoan infections in all cases. These protozoa appeared similar in morphology to myxozoans. This finding is important as we are using these wild stocks for breeding purpose. Investigation on the health status of the grouper, *E. tauvina* in the wild has been initiated using methods with tissues of thymus, gill, liver, spleen, heart, kidney, skin, eyes and brain.



Multiplex PCR with MBV, WSSV and KHV

Bioactivity profiles of seaweeds and associated microbial flora

- Methylene chloride/methanolic fractions from seaweeds *Turbinaria* sp. and *Padina* sp. were found to possess antibacterial activity (inhibition zone of 13-15 mm).
- Epiphytic *Pseudomonas fluorescens* and *Bacillus circulans* isolated from seaweeds *Laurencia papillosa* and *Turbinaria conoides* were found to possess antibacterial activity against pathogenic *Vibrio parahaemolyticus* with an inhibition zone of 12-13 mm and 18-19 mm, respectively. The nonpolar fractions from *P. fluorescens* broth culture given a R_f value of 0.60-0.80, whereas the polar fractions exhibited R_f value of 0.20-0.35. The dichloromethanic fraction from *B. circulans* furnished R_f value of 0.45-0.6, whereas the hexanic fractions exhibited higher R_f value (> 0.70).
- *Bacillus brevis* isolated from mangrove swamp was found to possess antibacterial activity against pathogenic *Vibrio parahaemolyticus* with inhibition zone of 18-19 mm. Chromatographic results of *B. brevis* hexanic concentrate revealed the presence of nonpolar compounds (with R_f value of >0.75 in 20% ethylacetate/ hexane), whereas the ethylacetate fraction revealed the presence of compounds with R_f values of 0.10-0.41.



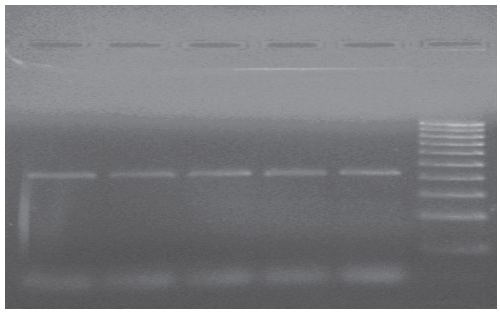
Low density microarray with MBV, KHV and WSSV

Detection of viral pathogens using DNA microarray

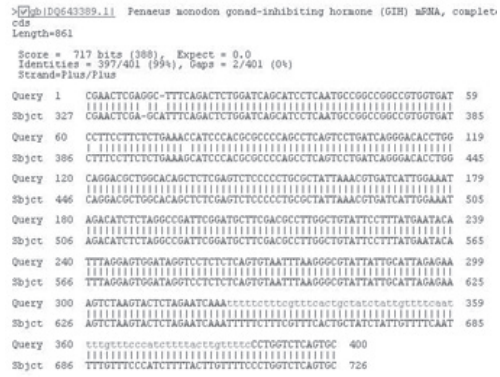
- A demo DNA microarray (Biochip) has been developed through a combined multiplex PCR and DNA microarray technology for the detection of three economically important viral pathogens affecting shrimps and carps (white spot syndrome virus (WSSV), monodon baculovirus (MBV) affecting shrimp and Koi Herpes virus affecting freshwater carps). The array is composed of three oligonucleotide probes, corresponding to specific sequences of these viral pathogens. Screening of the field samples using the low density microarray (Diagnostic viral DNA chip), showed, high sensitivity, specificity, and the whole process was completed within 6 h. The results demonstrated the possibility for the development of a single DNA microarray (Biochip) for the detection of all the reported viral pathogens of finfish and shellfish.

FUNDING AGENCY	**Department of Biotechnology**
PROJECT TITLE	**Development and application of CMG family recombinant hormones, their antagonists and RNAi technique for induced maturation and spawning of *Penaeus monodon***
SCIENTIST	**K.K.Vijayan**
CENTRE	Cochin

- Previous efforts made in the project to use degenerate primers designed from the available sequence data of CMG family hormones from American lobster *Homarus americanus*, Norway lobster *Nephrops norvegicus*, crayfish *Procambarus bouvieri and* shrimp *Metapenaeus ensis* to amplify the GIH, failed to produce any GIH related sequence. This may be due to the unique structure of GIH in penaeid shrimps. Recently the sequence of GIH from tiger shrimp from Thailand has been made available in the GenBank. Fresh primers were designed based on this sequence to test it in the Indian stock and evaluate the GIH. A partial cDNA fragment of 400 bp was amplified using primers:
- (Pm3F-5'-CGAACTCGAGCATTTCAGAC-3'and Pm.1.23R – 5'-GCACTGAGACCAGGGAAAAC-3'), designed from GenBank sequence (Acc.No.DQ643389). mRNA from eyestalk neurons of adult female *P. monodon* at different vitellogenic stages were used as the template for cDNA synthesis in this study using RT-PCR approach.
- The 400bp amplified product obtained was purified and sequenced. The sequence data of this product has shown 99% similarity with the 5' region of published Pem-GIH cDNA sequence, which is 861 bp in size with a single ORF of 288 bp when analysed using the BLAST tool. (http://www.ncbi.nlm.nih.gov/blast/Blast.cgi).



A 1.5% Agarose gel showing partial GIH gene products of (400 bp) using Pm 1.3F & Pm1.23R primers, Lane 1 400bp pcr product, Lane M 100 bp DNA ladder



BLAST result of the sequence data showing 99% similarity to Pm-GIH

FUNDING AGENCY	**Department of Biotechnology**
PROJECT TITLE	**Investigation on 'loose shell syndrome' among farmed tiger shrimp, *Penaeus monodon'***
SCIENTIST	**K.K.Vijayan**
CENTRE	Cochin

- As histological studies revealed marked histopathological manifestations in hepatopancreas and lymphoid organ, hepatopancreatic tissue were subjected for the ultrastructural investigation. Tissues of HP of LSS-affected shrimp were fixed and processed according to standard protocols with slight modifications. Ultra-thin sections were stained with 2% uranyl acetate and examined with TEM. TEM observations revealed the presence of virus-like electron dense particles of 12-15 nm size with a halo around the particles within the nuclei of hepatopancreatocytes. In some samples, the viral-like particles appeared to arrange in an ordered array. The present observations suggest the involvement of a viral-like agent affecting the normal function of the hepatopancreas.

FUNDING AGENCY	**ICAR APCess**
PROJECT TITLE	**Development of gene construct for producing WSSV resistant shrimp and its validation in shrimp cell culture system**
SCIENTIST	**P.C. Thomas**
CENTRE	Cochin

- The work component envisages the development of a primary cell culture system from penaeid shrimps for their transfection with the DNA constructs with white spot syndrome virus resistance.
- Trials for development of *in-vitro* of primary cultures of haemocytes and cells from heart, gills, hepatopancreas with different media and supplements revealed that medium M-199 along with 20% FBS (Osmolarity 720 and pH7.6) at temperature of 28^{0}C gave maximum proliferation and survival. Haemocytes were found to proliferate and by 7th day T-25 culture flasks had attained 80% confluency when it was split for the further proliferation. On the 9th day, the culture could be trypsinized and subcultured.
- Heart cells started proliferation after 36 h wherein spreading of star shaped cells in the culture flasks could be seen. Cells attained 80% confluency on the 5th day, when it was sub-cultured by mechanical method.
- Gill started proliferation after 3 days and 80% confluency was attained on the 5th day when sub-culturing it by mechanical method was attempted. They could be maintained viable for 7 days.
- Hepatopancreatic cells started proliferation after two days. Though viable for 7 days, cells didn not reach confluency.

FUNDING AGENCY	**ICAR Network Project**
PROJECT TITLE	**Application of microorganisms in agriculture and allied sectors (AMAAS): Microbial diversity and identification: Fish microbes**
SCIENTIST	**Imelda Joseph**
CENTRE	Cochin

- ***Fish Sample collection*:** Live fish samples were collected from different marine fishing sites of Trivandrum district, Kerala. The fishes collected live include *Johnius* sp., *Lutjanus* sp, *Siganus* sp, *Tetradon* sp, *Therapon* sp., *Abalistes* sp., *Siganus* sp. *and Acanthurus* sp. Collections were also made from Kanyakumari and Ramnad districts of Tamil Nadu during the report period. *Sardinella* sp., *Siganus* sp., *Cynoglossus* sp., *Epinepheles* sp., *Gerres* sp. were collected from Kanyakumari district and *Caranx* sp., *Carangoides* sp., *Siganus* sp., *Chanos* sp., *Leiognathus* sp., *Sillago* sp. were collected from Mandapam of Ramnad district.
- Eight pure bacterial isolates from milk fish *Chanos chanos* were identified up to genus level. From the skin isolates of milkfish *Flavobacterium*, *Streptococcus*, *Enterobacteriaceae*, *Planococcus* and *Alcaligenes* were identified. From the gill isolates, *Moraxella*, *Acinetobacter* and *Flavobacterium* were identified.
- Seventeen bacterial strains were isolated from the catfish *Arius* sp. up to genus level.
- Thirty two pure bacterial isolates were identified from Dhoma *Johnius* sp. up to genus level. From the skin isolates of Dhoma,

three *Bacilli*, seven *Pseudomonas*, three *Acinetobacter*, two *Moraxella*, seven *Alcaligenes*, three *Enterobacteriaceae*, and one *Arthrobacter* strains were isolated. From the visceral isolates, three *Alcaligenes*, two *Bacilli* and one *Lactobacillus* strain were identified.

FUNDING AGENCY	**DST (WOS-A)**
PROJECT TITLE	**Development of immunodiagnostics for the rapid detection of *Vibrio alginolyticus* pathogenic to farmed fish/shellfish**
SCIENTIST	**Gijo Ittoop** and K.S. Sobhana
CENTRE	Cochin

- Eight strains of *V. alginolyticus* were used for pathogenecity evaluation in juveniles of the Indian white shrimp, *Fenneropenaeus indicus* (2.0 $\pm$ 0.5 g) at concentrations of 10^4, 10^5, 10^6, 10^7 and 10^8 cfu animal^{-1}. It was found that two strains, V3 and V4 were pathogenic to shrimps causing 100% mortality at doses above 5 x 10^5 and 5 x 10^4 cfu g^{-1} body weight respectively. These two strains were also tested for pathogenecity in juveniles of the rabbit fish, *Siganus canaliculatus* (50 $\pm$ 3 g). It was found that only V4 was pathogenic to *S. canaliculatus* causing 100% mortality at doses above 2 X 10^7 cfu g^{-1} body weight.
- Strain V4 which was pathogenic to both *P. indicus* and *S. canaliculatus* was used for immunization of mice. Female Balb C mice were injected intraperitoneally with formalin killed V4 strain of *V. alginolyticus*. Two booster doses were given on day 15 along with FIA and day 27 with antigen alone. The sensitized spleen cells were collected on day 30 and fusion with myeloma cells was carried out. Repeated fusions are being carried out using different types of media (RPMI and DMEM) and with varying ratios of spleen and myeloma cells. Various fusion protocols and immunization schedules are being tried inorder to get positive clones for Mab production.

Technology Assessed & Transferred

Demonstration of mussel seeding to the practising farmers

CMFRI-NFDB training on Coastal Aquaculture

Inauguration of the one-day workshop on mussel farming at Veli near Cochin

Farmers / Fishermen Meetings for popularising technologies

- Demonstration of cultivation of tissue-cultured banana, var. Nenthran was inaugurated by the President, Mookkannur Grama Panchayat, at Mookkannur, near Angamaly on 5th October 2007. More than 25 beneficiaries participated in the programme.
- Front Line Demonstration of Mussel farming in marine environment was organized at Narakkal. More than 75 persons including farmers, fishermen, scientists, technicians, extension personnel and Members of local Panchayat administration participated in the programme inaugurated by Smt. Philomina Antony, President, Narakkal Grama Panchayat. Similar programme of mussel farming in brackishwater was also implemented at Gothuruthu in Pallipuram Panchayat of Vypeen Island.
- Jasmine Farmers' Meet was organized at Vengola near Perumbavoor on 22nd March 2008 as a part of the On Farm Testing programme of 'Application of Biocontrol Agents against Root rot disease of jasmine'. A lecture on the package of practices of jasmine cultivation by Dr.Mrs.Jyothi Bhaskar, Associate Professor, Kerala Agricultural University was arranged. Biocontrol Agents were also displayed for creating awareness among the farmers. The Meet was inaugurated by the Vice President of Vengola Grama Panchayat.The Meet was also participated by officials of the Department of Agriculture and Members of the Panchayat administration.

Dissemination of pearl culture technology

To disseminate the pearl culture technology, a survey was made to select a suitable site for setting up a demo farm with people's participation. Among the two surveyed villages *viz*., Tharaivikulam and Vellapatti near Tuticorin, the latter was selected.

Science Camp organised

The KVK organized a 'Science Camp on Coastal Aquaculture' for the benefit of the Second year students of VHSE (Aquaculture) of Govt. Regional Fisheries Technical Vocational Higher Secondary School, Thevara, Ernakulam from 27th November to 7th December 2007. A total of 23 students participated in the programme held at CMFRI Headquarters, Cochin.

Training for farmers in Mussel, Edible Oyster and Sea weed

Place	Date	Training		Participants		Organised by
		Topic	No	Men	Women	
(i) Kerala						
Valiyapanikkanthuruth Trichur Dt.	03.01.07	Mussel farming	1	15	-	RGCCS
Valiyapanikkanthuruth Trichur Dt.	02.02.07	Mussel farming	1	15	-	RGCCS
Valiyapanikkanthuruth Trichur Dt.	30.03.07	Mussel farming	1	15	-	RGCCS
ATIC Hall CMFRI	15.06.07	Farming of marine mussels & edible oyster	1	23	2	CMFRI, KVK & NFDB
ATIC Hall CMFRI	28.07.07	Farming of marine mussels & edible oyster	1	16	8	CMFRI, KV & NFDB
Cheriyakadavu, Chellanam	27.09.07	Mussel farming	1	42	55	CSSS & CARITAS, India
ATIC HallCMFRI	30.11.07	Farming of marine mussels & edible oyster	1	-	23	Students GFHSSS, Thevara CMFRI, KVK & NFDB
State Fish. Dept. Kozhikode	11.12.07	Mussel farming	1	6	24	ADAK & CMFRI
Gandhi Memorial Vayana shala, Moothakunnam	17.12.07	Mussel farming	1	20	4	ADAK Ernakulam
ATIC HallCMFRI	22.02.08	Farming of marine mussels & edible oyster	1	13	17	CMFRI, KVK & NFDB
State Fisheries Regional Shrimp Hatchery Auditorium, Azhikode	18.03.08	Mussel farming	1	28	17	Gramapanchayat, Eriyadu.
Central Kerala		Sea weed farming	6	51	69	KVK, NFDB & CMFRI
(ii) Karnataka						
Kundapura,Uduppi	21.06.07	Mussel and oyster farming	1		30	Dept. of Fisheries, Karnataka & BFFDA, Udupi.
College of Fisheries, Mangalore	07.01.08	Mussel and oyster farming	1		25	Dept. of Fisheries, Karnataka & NFDB

Special Infrastructure Development

New fishery biology facility in PFD lab

Newly installed Reverse Osmosis plant for water purification at Mandapam Regional Centre

New laboratory-cum-office building at Tuticorin

Infrastructure facilities developed at CMFRI Headquarters, Cochin

- The audio and projection system of ATIC Audio Visual Hall have been further improved with latest 5 in 1 home theatre system US based Klipsch speakers, with wider motorized high grain screen of 12' x 9' dimension along with a high resolution LCD projector of 4000 lumens for movie projection.
- A modern fishery biology facility was established in the Pelagic Fisheries Division laboratory

Infrastructure facilities developed at Mandapam Regional Centre

- An outdoor facility for broodstock development of marine finfish was developed.
- A fish farm was developed in which integrated farming of shrimp with seaweed is being conducted.
- One of the laboratories was converted into Marine Research Aquarium for biodiversity and coral reef research.
- Two R.O. Plants were installed and made functional from 1st December, 2007 and R.O. water is being supplied to the residents daily.

Infrastructure facilities developed at Madras Research Centre

- Conference Hall with a capacity to seat 60 people developed.
- Two computers with printers were procured for Cuddalore and Ongole Field Centres.

Infrastructure facilities developed at Vizhinjam Research Centre

- A high pressure sand filtration system with UV sterilization was fabricated and installed in the hatchery.

Infrastructure facilities developed at Tuticorin Research Centre

- A new laboratory-cum-office building was established.
- A translucent laboratory with an area of 45 m^2 was added to the facilities for mixed algal culture.

Infrastructure facilities developed at KVK, Narakkal

- A small-scale coconut nursery has been established with 500 nuts collected from selected trees with ideal features.
- Instructional facilities including racks for sun drying of fish /shrimps and fish dressing table with water supply and drainage systems were developed.

Human Resource Development

Postgraduate Programme In Mariculture

Ph. D. Programme

The following SRFs of regular and sponsored projects of the Institute were awarded Ph.D. degree

Name of student	Supervising Teacher	Title of Thesis	University
Sh. Ramalinga	Dr. V. Kripa	Environmental impact assessment of suspended oyster, *Crassostrea madrasensis* (Preston) culture	CIFE
Sh. Sushanta Kumar Patra	Dr. K. C. George	Histomorphological characterization of immune system in greasy grouper, *Epinepheles tauvina* (Forskal, 1775)	CIFE
Sh. A. Chandrasekara Rao	Dr. L. Krishnan	Some studies on reproductive physiology of the female grouper, *Epinepheles diacanthus* (Valenciennes)	CIFE
Smt. Bindhu, K.B.	Dr. C.P. Gopinathan	Studies on diatoms along the south-west coast of India in relation to the hydrological parameters	CUSAT
Sh. Abdu Rahiman, K.P.	Dr. K.S. Mohamed	Studies on food and feeding of marine demersal finfishes with special reference to trophic interactions	CUSAT
Sh. U. Unnikrishnan	Dr. R. Paul Raj	Nutritional value of fresh, processed and formulated diets for the green mud crab, *Scylla serrata* juveniles	CUSAT

- Shri M. Sivadas was awarded the Degree of Doctor of Philosophy by Manonmaniam Sundaranar University, Tirunelveli for his thesis entitled "Studies on the fishery, biology and population dynamics of skipjack tuna *Katsuwonus pelamis* (Linnaeus, 1758) from Minicoy, Lakshadweep".
- Shri Joe K. Kizhakudan was awarded the Degree of Doctor of Philosophy of the University of Bhavnagar, Gujarat, in December 2007 for his work on "Reproductive biology, ecophysiology and growth in the mudspiny lobster, *Panulirus polyphagus* (Herbst, 1793) and the sand lobster, *Thenus orientalis* (Lund, 1793)".
- Shri S.R. Krupesh Sharma was awarded the Degree of Doctor of Philosophy by Karnataka Veterinary, Animal & Fisheries Sciences University, Bidar for his thesis entitled "Pathobiological studies of *Vibrio alginolyticus* biofilm on the defense functions and disease resistance in giant tiger shrimp (*Penaeus monodon*)**".**
- Smt. Sujitha Thomas was awarded the Degree of Doctor of Philosophy of the University of Calicut, Kerala in December 2007 for her thesis entitled "Studies on some aspects of biology and population dynamics of short-neck clam *Paphia malabarica* (Chemnitz) in Dharmadom Estuary, North Kerala, Southwest coast of India".
- Shri V. Mohan was awarded the degree of Doctor of Philosophy in Library and Information Science by the Annamalai University in December 2007 for his thesis entitled "Mapping of Coral Reef Research Literature: A global perspective".

Krishi Vigyan Kendra

Launching of raft for rope culture of mussel in the sea off Narakkal inaugurated by Smt. Philomina Antony, President, Narakkal Panchayath

As per the mandatory objectives, the Krishi Vigyan Kendra has organized training programmes for different categories of beneficiaries, Front Line Demonstration programmes, On Farm Testing programmes and other extension activities during the year under report, aimed at promoting area development, employment generation, technology assessment/ refinement/upgradation and increasing production in agricultural and allied sectors.

Training programmes

A total of 69 training courses for 1390 villagers including 20 courses in Fisheries for 402 persons, 19 courses in Agriculture for 398 persons and 30 courses in Home Science for 590 persons were organized. Training courses, both on-campus as well as off-campus were organized for the benefit of practicing farmers, rural youth and extension personnel.

a. Practising farmers (On-campus)

Discipline	Course Title	No. of courses conducted	Number of participants			
			Male	Female	Total	SC
Fisheries	Breeding & Rearing of the Pearl spot, *Etroplus suratensis*	1	34	5	39	8
Agriculture	Preparation of Shrimp pickle	1		5	5	
Home Science	Fish dressing Centres & Solar drying of fish	3		60	60	12
	Total (a)	**5**	**34**	**70**	**104**	**20**

b. Practising farmers (Off campus)

Discipline	Course Title	No. of courses conducted	Number of participants			
			Male	Female	Total	SC
Fisheries	Coastal aquaculture	5	67	53	120	70
	Mussel culture	1	20	11	31	
Agriculture	Kitchen gardening	3	16	44	60	10
	Organic farming	2	28	9	37	8
	Coconut cultivation	1	3	27	30	
Home Science	Fish processing	2		43	43	4
	Detergent powder preparation	1		20	20	
	Total (b)	**15**	**134**	**207**	**341**	**92**

c. Rural Youth (On campus)

Discipline	Course Title	No. of courses conducted	Number of participants			
			Male	Female	Total	SC
Agriculture	Mushroom spawn production	3	11	42	53	13
Home Science	Toilet soap preparation	2		29	29	10
	Fish processing	1		22	22	2
	Total (c)	**6**	**11**	**93**	**104**	**25**

d. Rural Youth (Off campus)

Discipline	Course Title	No. of courses conducted	Number of participants			
			Male	Female	Total	SC
Fisheries	Ornamental fish culture	7	77	20	97	
	General aquaculture practices	1	9	6	15	
	Brackishwater fish farming	1	11	9	20	5
Agriculture	Vegetable cultivation	1	1	19	20	1
	Vermi compost	2		41	41	9
	Mushroom cultivation	3		56	56	19
	Organic farming	1	8	17	25	9
	Kitchen gardening	2	6	54	60	
Home Science	Toilet soap preparation	2		33	33	5
	Dish washing powder	2		35	35	15
	Fruit preservation	4		74	74	16
	Detergent powder	1		15	15	5
	Fish processing	5		110	110	33
	Fish Kiosk management	1	7	10	17	
	Mushroom pickle preparation	1	5	43	48	
	Drudgery reduction	2		45	45	20
	Total (d)	**36**	**124**	**587**	**711**	**94**

e. Extension personnel (On-campus)

Discipline	Course Title	No. of courses conducted	Number of participants			
			Male	Female	Total	SC
Fisheries	Shrimp farming	1	7	10	17	1
	Fish production & Processing	1		27	27	
Agriculture	Mushroom cultivation	1		16	16	4
Home Science	Fish processing	1	4	15	19	
	Drudgery reduction	1	3	12	15	4
	Total (e)	**5**	**14**	**80**	**94**	**9**

f. Extension personnel (Off-campus)

Discipline	Course Title	No. of courses conducted	Number of participants			
			Male	Female	Total	SC
Fisheries	Coastal aquaculture	1		23	23	1
	Ornamental fish culture	1	7	6	13	
Agriculture						
Home Science						
	Total (f)	**2**	**7**	**29**	**36**	**1**
	Total of (a)+(b)+(c)+(d)+(e)+(f)	**69**	**324**	**1066**	**1390**	**241**

Farmer lifting mussel rope in Ernakulam District

Trainees observing Solar drier at CIFT, Cochin

Self Help Group preparing fish products at KVK

Training programmes funded by National Fisheries Development Board

Training programmes reported under Fisheries and Home Science included 5 courses on coastal aquaculture for 120 farmers and 3 courses on fish dressing centres & solar drying of fish for 60 coastal women, funded by the National Fisheries Development Board.

Coastal aquaculture

The course covered various aspects like coastal aquaculture environment and resources, coastal aquaculture act, shrimp farming, fattening and grow-out farming practices of mud crab, brackishwater finfish farming, farming of mussels and oysters, seaweed farming, integrated farming, water and soil quality management, nutritional requirements, disease management and financing schemes.

The faculty members included subject matter specialists of the Institute as well as other organizations including Department of Fisheries, Govt. of Kerala and Fisheries and Rice Research Stations of Kerala Agricultural University. The trainees were also taken to different farms with a view to provide them with necessary exposure to different culture practices.

Fish dressing centers and solar drying of fish

Apart from the instructional facilities including the services of resource persons available at the KVK, those of different organizations such as the Central Institute of Fisheries Technology (ICAR), Integrated Fisheries Project (Govt. of India) and Matsyafed (Govt.of Kerala) were made use of towards implementing the programme effectively. Topics such as dressing of fish under ideal conditions and preparation of diversified products including pickle, wafers, cutlet, fish balls from finfish and shellfish, solar drying of fish and packing and marketing of fishery products were covered.

Front Line Demonstration [FLD] & On Farm Testing [OFT]

Discipline	Programmes	
	Activities under FLD	Activities under OFT
Fisheries	Rope culture of mussels on rafts in marine environment at Narakkal and on racks in backwater at Gothuruthu in Ernakulam District	1. Culture of hatchery produced finfish, seabass, *Lates calcarifer* 2 Breeding & rearing of freshwater ornamental fishes using the feed developed by CMFRI
Agriculture	Cultivation of tissue culture banana: in Mookkannur village near Angamaly in Ernakulam District	Disease management in jasmine farming using biocontrol agents, *Trichoderma* & *Pseudomonas*
Home Science	Fabrication and use of Hay Box for energy saving in cooking and drudgery reduction	

Awards & Recognitions

- Dr. N.G.K. Pillai has won the prestigious "Eminent Zoologist Gold Medal" instituted by the Zoological Society of India, Calcutta.
- Dr. C. Ramachandran, Dr. R. Sathiadhas, Shri Said Koya and Shri Muhasin won the ''Joint Best Paper Award' during the Special Symposium on 'Gender and Fisheries' at the 8th Asian Fisheries Forum, Cochin.
- Dr. V. Kripa and Dr.V.P. Vipinkumar bagged the award for the 'Commended Paper' during the Special Symposium on 'Gender and Fisheries' at the 8th Asian Fisheries Forum, Cochin.
- Smt. T. S. Naomi, Scientist (SG) won the best paper award during the Hindi Chetana Maas celebrations of CMFRI.
- Dr. Kajal Chakraborty, Scientist won the Pran Vohra Award (2007-2008) from the Indian Science Congress Association.
- Dr. (Mrs.) P.S. Swathi Lekshmi was awarded the Jawaharlal Nehru Award for the outstanding Post-Graduate Agricultural Research-2006 in Social Sciences by ICAR for her research entitled "Computer simulation modeling for forecasting of diffusion and decision support for shrimp farming".
- Dr. Jyothi V. Mallia, Research Fellow in the MoES Project received the Jawaharlal Nehru Award for Post-Graduate Agricultural Research-2006 for her Ph.D. thesis on "induction and evaluation of triploidy in *Crassostrea madrasensis* (Preston)". The research work was carried out under the guidance of Dr. P. Muthiah and Dr. P.C. Thomas was the Co-Guide.
- CMFRI Headquarters and Mangalore Research Centre won the best Official Language Implementation Award from the TOLIC concerned.
- Certificate of Merit was awarded to Dr.C.Muthiah, Pricncipal Scientist and former Scientist-in-Charge, MRC of CMFRI, Mangalore by the Mangalore Town Official Language Implementation Committee in recognition of his outstanding performance in the implementation of the Official language Policy of the Government of India and in promoting the use of Hindi in Official work during the year 2006-07.
- Smt. T.S. Naomi won the Nakad Puraskar for best paper in Matsya Gandha 2006.
- Dr. A.P. Dinesh Babu and Shri. G.S. Bhat received the Nakad Puraskar for best paper in Matsya Gandha 2006.

Recognition as Designated National Repository

- The Government of India in consultation with the National Biodiversity Authority has designated the Central Marine Fisheries Research Institute, Cochin as a "**Designated National Repository**" under the Biological Diversity Act, 2002 ('National Repository' is an Institution designated by Government of India to keep in safe custody, specimens of different categories of biological material)
- The collections of the 'Marine Biodiversity Referral Museum' is being regularly updated and currently the museum houses 1530 species belonging to different phyla. The new additions to the museum during the year 2007 include:

  31 species of finfishes

  12 species of gorgonids

  23 species of marine algae and

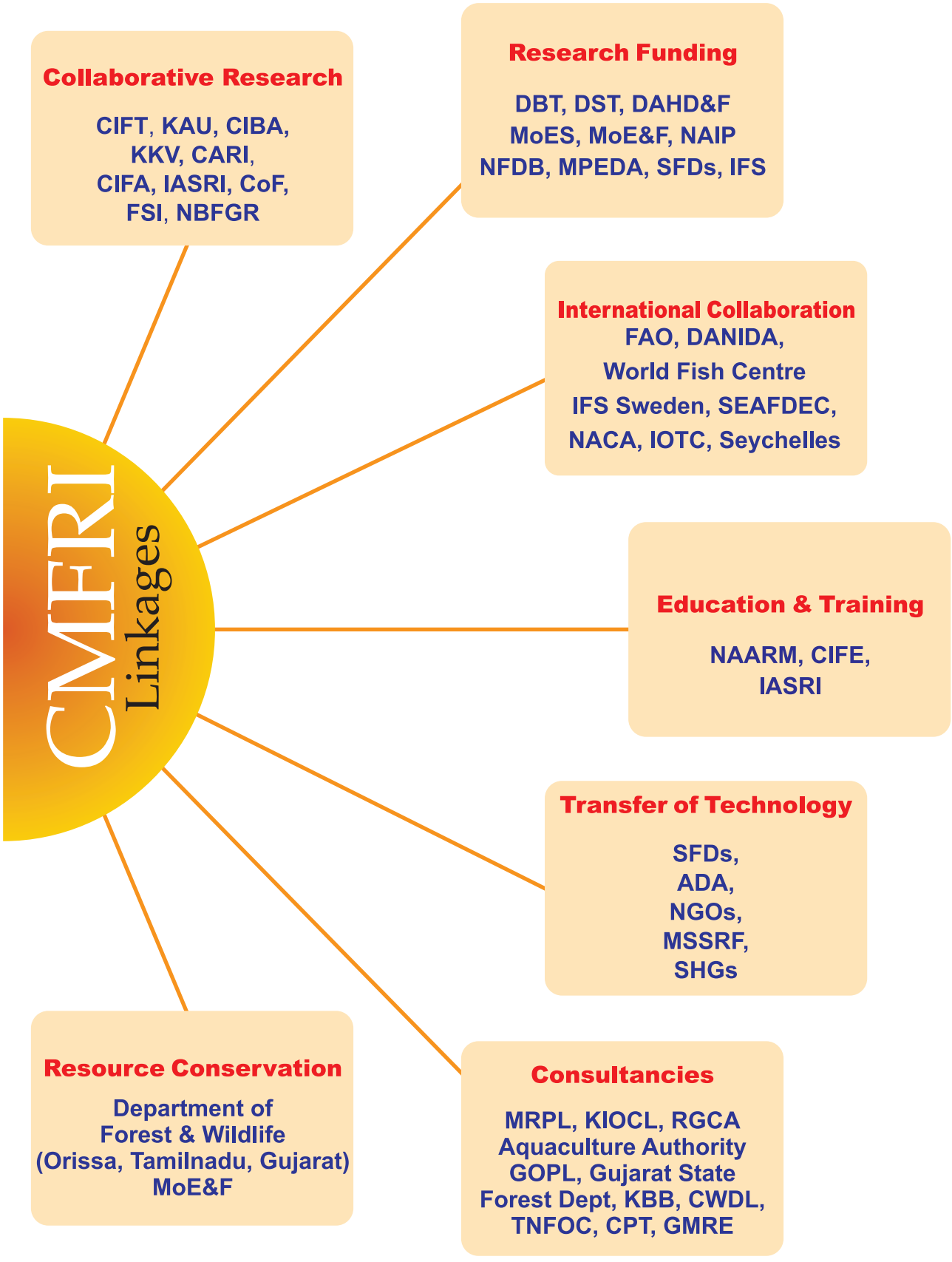
  1 species of deep-sea sponge

The winners or the 'Joint Best Paper Award' Dr.C. Ramachandran, Dr.R. Sathiadhas, Sri. Said Koya and Shri Muhasin along with Dr.Merryl Williams, in the 8th Asian Fisheries Forum' Special Symposium on 'Gender and Fisheries'.

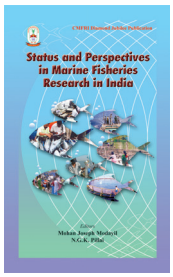
Dr. V. Kripa receiving the award for the 'Commended Paper' during the Special Symposium on 'Gender and Fisheries' at the 8th Asian Fisheries Forum

Dr. Vipinkumar, V.P. receiving the award for the 'Commended Paper' in the 8th Asian Fisheries Forum' Special Symposium on 'Gender and Fisheries'

Marine Biodiversity Referral Museum


CMFRI
Linkages
Collaborative Research
CIFT, KAU, CIBA,
KKV, CARI,
CIFA, IASRI, CoF,
FSI, NBFGR
Research Funding
DBT, DST, DAHD&F
MoES, MoE&F, NAIP
NFDB, MPEDA, SFDs, IFS
International Collaboration
FAO, DANIDA,
World Fish Centre
IFS Sweden, SEAFDEC,
NACA, IOTC, Seychelles
Education & Training
NAARM, CIFE,
IASRI
Transfer of Technology
SFDs,
ADA,
NGOs,
MSSRF,
SHGs
Consultancies
MRPL, KIOCL, RGCA
Aquaculture Authority
GOPL, Gujarat State
Forest Dept, KBB, CWDL,
TNFOC, CPT, GMRE
Resource Conservation
Department of
Forest & Wildlife
(Orissa, Tamilnadu, Gujarat)
MoE&F

Publications



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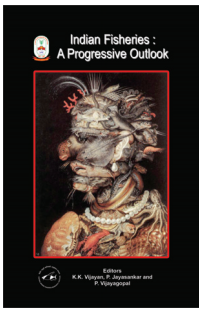

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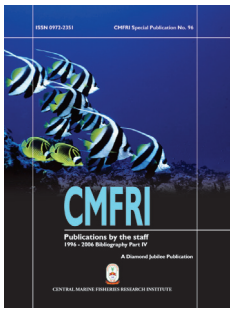

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Workshops Seminars and Training Programmes Organised

Workshops

- Under the HRD programme, a workshop-cum-training on 'Skill Enhancement for Marine Fisheries Resources Data Collection' was organized by FRA Division for the field staff of CMFRI from 16-18 April, 2007 at CMFRI, Cochin.
- Conducted a workshop on 'Trophic Modeling, NWC Ecosystem, Fishery Simulations' and discussions with the Project associates at Mumbai Research Centre from 24th to 29th February, 2008.

Training Programmes

- A training programme on 'Usage of Software for Marine Fish Catch Assessment' was conducted by FRA Division for a participant from the Office of the Commissioner of Fisheries, Andhra Pradesh at CMFRI, from 7-10 May, 2007.
- Three apprentice trainees under the State Govt. PASAA Scheme have been initiated by FRA Division in to a six month IT applications training module from 3rd September, 2007.
- A computer training programme on 'Extracting the Maximum from Electronics Spreadsheets' was organized by FRA Division under HRD for administrative staff from various Research/Regional/Field Centres of CMFRI from 18-26 February, 2008 at CMFRI, Cochin.
- A training programme on 'Advanced and customized use of common application software' was organized by FRA Division under HRD for technical staff from various Research/Regional/Field Centres from 27th February – 5th March 2008 at CMFRI.
- The Marine Biotechnology Division conducted 3 days training on 'Techniques of Food Analysis' from 9-11 July 2007 for 10 M.Sc. Nutrition students of Alphonsa College, Pala.
- A one day training programme on ornamental fish keeping was organized by Vizhinjam Research Centre at YMCA hall, Trivandrum which was sponsored by YMCA. The programme was attended by 20 fish farmers.
- The Visakhapatnam Regional Centre imparted hands-on-training on cage culture to 21 fishermen from three villages both from Visakhapatnam and Srikakulam districts of Andhra Pradesh. The fishermen were trained on cage fabrication and launching in the sea.

- A one day outreach programme on 'Self Help Groups & Credit and Finance' was organised by the SEETT Division at Arattupuzha in Alappuzha district on 17th September 2007. Dr. Vipinkumar.V. P. welcomed the gathering of 52 fisherfolk and Dr.R.Sathiadhas, Head, SEETT Division presided over the function. The function was formally inaugurated by Smt. Pushpalatha Solaman, the President of Arattupuzha Panchayat. Dr.K.Balasubramanian, Lead Bank Manager, SBT, Sri.K.B. Subhash Chandran, District Manager, Matsyafed, Smt. Sreekumari, Asst. Manager, Sri.P.S. Sasidharan, Extension Officer, FFDA and Dr.A.K.Unnithan, Training Organiser of KVK, Narakkal dealt with the sessions on Self Help Groups.
- A one day outreach programme on 'Mussel Farming' was organized by the SEETT Division at Cheriyakadavu in Ernakulam district on 27th September 2007. A total of 77 fisherfolk participated. Dr.R.Sathiadhas, Head, SEETT Division and Dr.Sunil Kumar Mohammed, Head, MFD gave the key note address. Shri.Antony, Vice President of the Chellanum Gramapanchayath presided over the function. The function was formally inaugurated by Shri. Antony Sheelan, the President of Palluruthy block Panchayat. Smt.Jenny and Mr.Alocious, Technical Assistants and Dr.A.K.Unnithan, Training Organiser of KVK, Narakkal dealt with the sessions.

Outreach programme on 'Fisheries credit and finance' at Arattupuzha

Winter School conducted

- CMFRI conducted ICAR sponsored Winter School "Impact of Climate Change on Indian Marine Fisheries" for 22 participants for 21 days from 18th January to 7th February 2008 at Cochin. The participants were from ICAR Institutions, Universities and colleges. The winter school was inaugurated by Shri.N.Ramachandran, IPS, Chairman, Kochi Port Trust. Dr.K.Mohankumar, Dean, School of Marine Sciences, Cochin University of Science and Technology delivered the keynote address. The Winter School consisted of theory and practical sessions. The participants were exposed to diverse areas related to climate change such as marine fishery resources, environment and marine fisheries, climate change, climate change and marine fisheries, marine ecosystems, harvest and post-harvest technologies, climate change and Indian agriculture, statistical and analytical tools etc. The faculty included scientists from CMFRI, CIFT, NIO, Kerala Agricultural University and Fisheries College, Panangad. The lecture notes consisting of 54 papers were printed and distributed to the participants.

Release of Winter School manual by Shri. N. Ramachandran IPS

Winter School session in progress

Awareness Programmes

- A total of 23 Awareness Programmes were organized at CMFRI Headquarters, Cochin on 'Sustainable Fisheries Management and Coastal Aquaculture' in which 720 persons were benefited.

Foundation Day at Mandapam Regional Centre

- A Diamond Jubilee celebration and the Foundation Day of the Institute was celebrated at Mandapam Regional Centre on 4th February, 2008. On this day, there was an 'Open House' for the public, school and college students. In the evening, there was a cultural programme in which all staff, family members and nursery school children participated and prizes were distributed to the participants.

Quiz competitions held

- A 'Biotechnology Quiz' was conducted by the Marine Biotechnology Division on 30th November 2007 in which six teams from different colleges/institutes participated. The quiz was an admixture of basic and applied questions, testing their knowledge on historical and modern developments in genetics and biotechnology. First prize was won by Mar Athanasius College, Kothamangalam, second prize by Al-Ameen college, Edathala and the third prize was won by CMFRI/NBFGR. The Director addressed the participants and distributed the cash award and certificates to the winners.
- The Mangalore Research Centre organized a quiz competition for the high school students of Mangalore city on 15th August, 2007. The first prize was won by Vinayak Kamat and Ashwin Shenoy, Canara High School and Second prize was won by Pallavi Alse and Aravind Sudhakar of Kendriya Vidyalaya No. 1.

Essay competition

- An Essay writing competition was conducted by the Mangalore Research Centre for Higher secondary school students in the month of July 2007. Suraj Satyanarayana, Sharada PU College won the first prize and and Aneesh M. Kendriya Vidyalaya No. 1 won the second prize.

Brain storming on 'Marine Fisheries of Andhra Pradesh'

- A brain storming on the theme "Marine Fisheries of Andhra Pradesh" was organized on 12th October 2007. Shri. Mandali Buddha Prasad, the Hon'ble Minister of Fisheries, Andhra Pradesh was the Chief Guest. Dr.G. Syda Rao welcomed the gathering. In his welcome address, he briefly explained about the research activities of the Centre and also about the ongoing cage culture demonstration. Dr. K. R. Prasad gave the presidential address where he highlighted the fisheries status of Andhra Pradesh and the contributions made by Regional Centre of CMFRI for the development of marine fisheries sector in the state of Andhra Pradesh. The Chief Guest Shri. Mandali Buddha Prasad declared open the ceremony by lighting the lamp. He appreciated the research work undertaken by the Centre and stressed the importance of marine fisheries in Andhra Pradesh and about its employment potential. During his address, he also mentioned about the subsidy given for diesel and other development measures taken by the Government for the welfare of the fishing community. Dr. Kasim, SIC, Visakhapatnam Centre of CIFT gave the felicitation address. Dr. P. Kaladharan, Senior Scientist proposed the vote of thanks.
- The programme which evoked good response was attended by officials of State Govt. Departments, Universities and Scientists from CIFT, CMFRI, besides retired scientists of CMFRI and other Institutes. The session witnessed valuable suggestions from all the participants for the development of marine fisheries sector in the state of Andhra Pradesh.

Dignitaries on the dais during the brain storming on 'Marine Fisheries of Andhra Pradesh'

Approved Ongoing Projects

In-house Projects

SL. NO.	Project Code No.	Title of the Project
1	FRA/ASSESS/01	Development of knowledge based information system for marine fisheries sustainability
2	FRA/ASSESS/02	Decision support system for marine fisheries management
3	PEL/IDP/01	Management advisories for sustaining marine fisheries of Kerala and Lakshadweep.
4	PEL/IDP/02	Management advisories for sustaining marine fisheries of Karnataka and Goa
5	DEM/IDP/01	Management advisories for sustaining marine fisheries of Tamilnadu and Puducherry
6	DEM/IDP/02	Development of management advisories for sustaining marine fisheries of Gujarat
7	CF/IDP/01	Management advisories for sustaining marine fisheries of Maharashtra
8	CF/IDP/02	Resource damage assessment in marine fisheries: impact of selective fishing of juveniles and by-catch and discards in trawl fisheries
9	MF/IDP/01	Developing management advisories for sustaining marine fisheries of Andhra Pradesh
10	MF/IDP/02	Application of trophic modelling in marine fisheries management
11	FEM/01	Impact of anthropogenic activities on coastal marine environment and fisheries
12	FEM/02	Impact and yield study of environmental changes on distribution shifts in small pelagics along the Indian coast
13	SEE/PMS/01	A diagnostic study on dimensions, causes and ameliorative strategies of poverty and marginalisation among the marine fisherfolk of India
14	SEE/PEM/01	Benefit cost analysis of marine fishery business and alternative investment options
15	PNP/BIOT/01	Biotechnological applications in mariculture and conservation
16	PNP/NUT/01	Formulation and evaluation of larval and growout feed for marine crabs, lobsters, ornamentals and cage farmed finfish
17	MD/IDP/01	Technology development for seed production of shellfish
18	MD/IDP/02	Development of diversified mariculture systems
19	MD/IDP/03	Development of brookstock, captive breeding and seed production techniques for selected marine food fishes and ornamental fishes
20	MBD/RE/01	Understanding the threatened coral reef ecosystems of southern India and designing interventions aimed at their restoration
21	MBD/02	Development of systematic database on marine finfish and shellfish biodiversity of Indian seas

Sponsored Projects

SL. NO.	Project Code No.	Title of the Project
1	APC (NET)/38	Impact, adaptation and vulnerability of Indian agriculture to climate change
2	APC (NET)/55	Impact of fisheries research in India
3	APC(NET)/54	Investigation on 'Loose Shell Syndrome' among farmed tiger shrimp *Penaeus monodon*
4	APC/19	Technological upgradation of edible oyster farming through development of remote setting and upwelling techniques
5	APC/24	Cattle feed production from selective seaweeds of Indian coast
6	APC/25	Economic evaluation of trawl fishing in Andhra Pradesh and Kerala
7	APC/26	Assessing the impact of fishing on the biodiversity of commercial marine fishery resources of South west coast of India
8	APC/29	Seed production, farming and production of soft shelled crabs of *Portunus pelagicus* (Linnaeus)
9	DBT/09	Development and application of CMG family Recombinant Hormones, their Antagonistics and RNAi Technique for induced maturation and spawning of *Penaeus monodon*
10	DBT/10	Development of Genetically improved strains of Brine Shrimp Artemia using Quantitative and Molecular Genetic Tools
11	DBT/11	Development of species-specific DNA markers in economically important shellfish species green mussel (*Perna viridis*) and edible oyster (*Crassostrea madrasensis*) for their application in farming and resource management
12	DOD/09	Farming and pearl production in Black lip pearl oyster *Pinctada margaritifera* in Andaman waters
13	DOD/13	Resource assessment and biology of Deep sea fishes along the continental slope of Indian EEZ
14	DOD/13	Assessment of fishery resources along the Indian continental slope and central Indian ocean
15	DOD/14	Tuna resources of the Indian EEZ - An Assessment of growth and migratory patterns
16	DOD/15	Commercialization of marine pearl culture
17	DOD/16	Assessment of Myctophid resources in the Arabian sea and development of harvest and post harvest technologies
18	DSR-ICAR/01	Seed production in agricultural crops and fisheries
19	DST-FT/03	Characterization of novel antioxidants from red and brown seaweed from Gulf of Mannar
20	MES/CMLRE/08-07	Studies on marine mammals of Indian Exclusive Economic Zone and the contiguous seas
21	N/A	Development of gene constructs for production of WSSV resistant penaeid shrimp and its validation in shrimp cell culture system
22	N/A	Floating cage farm for marine finfish and shellfish
23	MPD/7	Demonstration of responsible fishing practices for the trawl fisheries of Gujarat State
24	MPD/6	Participatory management and conservation of lobster resources along the south west Indian coast
25	NAIP	A value chain on oceanic tuna fisheries in Lakshadweep sea
26	ICAR mega/05	Application of microorganisams in agriculture and allied sectors. Sub Project: Microbial diversity and identification-Fish Microbes

Consultancies & Patent Filing

Consultancies during the year 2007-2008

Sl.No	Name of Client	Project Title	Duration	Amount (Rs.)
1	M/s. Maharashtra Maritime Board, Indian Mercantile Chambers, R.K.Marg, Ballard Estate, Mumbai-400038.	Assessment of fish production and likely financial losses to fishers due to development of Rewas-Aware Port in Mumbai.	Sept.2007-Aug.2008	40,16,682
2	M/s.GMR Energy Ltd, Mangalore	Monitoring studies on the hydrobiological conditions in the Arabian Sea off Thanirbavi, near the marine outfall of Thanirbavi power plant facility M/s. GMREL, Mangalore (Phase-6)	Oct.2007-May2008	4,49,305
3	M/s. Maharashtra Maritime Board, Indian Mercantile Chambers, R.K.Marg, Ballard Estate, Mumbai-400038. Creek, Mumbai.	Impact of development of a jetty at Killa bunder on fishing activities in Vasai	Oct.2007-Aug.2008	15,48,400
			Total Amount	**60,14,387**

National Patent Filing

Received the National Provisional Patent Filing Number: 203/CHE/2008 from the Patent office, Chennai for the patent on 'A phytase produced extracellularly from thermophilic bacterium' filed by Paulraj, R., Imelda Joseph and Kajal Chakraborty.

Meetings

RESEARCH ADVISORY COMMITTEE MEETING

The 12th Research Advisory Committee (RAC) meeting was held at CMFRI Headquarters, Cochin on 17th August 2007. Dr. S.D. Tripathi chaired the meeting. The Members who attended the meeting included Dr.V.S.R. Murty, Dr. A.G. Untawale, Dr.Usha Goswami, Dr.P.Kumar, Shri Joseph Varghese and Prof. (Dr.) Mohan Joseph Modayil. Dr. R. Paul Raj was the Member Secretary. At the outset, Director of the Institute Prof. (Dr.) Modayil welcomed the Chairman and all the Members for the RAC meeting. In his introductory remarks, the Chairman complemented the Institute for its contribution during the last 60 years. The Director made a comprehensive presentation highlighting various aspects including the revised mandate, budget utilization, on-going research projects, consultancy services, thrust areas in the XI Plan and publications. Some of the major recommendations that emerged during the RAC meeting included:

- Developing marine fisheries forecasting models based on the data generated during the last 60 years.
- Proper assessment of marine fisheries of Orissa and West Bengal, with special reference to the impact of exploitation of larvae and juveniles in West Bengal.
- That there is an urgent need for strengthening research on the taxonomy of commercially important marine organisms.
- Estimation of the potential yields of the Indian EEZ.
- Research projects to be undertaken on corals, sea snakes, mangroves and sea cucumbers need to be formulated.
- Establishment of a marine gene bank at the Institute.
- A renewed thrust needed for research on gender issues.
- A greater emphasis for open-sea cage culture.

STAFF RESEARCH COUNCIL MEETING

The 15th Staff Research Council (SRC) meeting was held at CMFRI Headquarters, Cochin from 14-19 March, 2008. Dr. N.G.K. Pillai, Director was the Chairman and scientists from Headquarters as well as from various Regional and Research Centres attended the meeting. Dr.E.V. Radhakrishnan, Member Secretary welcomed Director and all the scientists for the SRC. Chairman while appreciating the progress made in the research front also praised the staff for carrying out the assigned duties in connection with the Diamond Jubilee celebrations of the Institute. The Chairman stressed the need for strengthening our ties with all the maritime states of the country and urged the SICs of Regional and Research Centres to organize workshops, inviting the concerned stakeholders.

SRC in progress during March 2008

The minutes of the 14th SRC was unanimously approved by the SRC. The Heads of Divisions presented the achievements of their respective Divisions, during the previous year. There were 21 on-going in-house research projects and the salient achievements and progress made by

these projects were presented by the respective Principal Investigators and Co-investigators for review by the SRC. Six new projects were also approved by the SRC.

INSTITUTE MANAGEMENT COMMITTEE MEETING

The 66th meeting of the Institute Management Committee (IMC) of CMFRI was held on 27th March, 2008 at CMFRI Headquarters. The Director of the Institute Dr. N.G.K. Pillai, chaired the meeting. The Members *viz*., Dr. (Mrs.) Mary K. Manisseri, Principal Scientist & Head, Marine Biodiversity Division, CMFRI, Shri Joseph Varghese, M/S. Aquamarine Export Ltd., Cochin, Dr. M. Krishnan, Principal Scientist, CIBA, Chennai and Member Secretary Smt. Roja Sethumadhavan, Senior Administrative Officer, CMFRI attended the meeting. At the outset, the Chairman highlighted the achievements and the progress made by the Institute during the previous year. He also presented the major activities undertaken by CMFRI. This was followed by the approval of the minutes of the previous IMC meeting held on 21st March 2007. The Member Secretary presented the Action Taken Report on the items for which action was sought during the previous IMC meeting. The 66th IMC recommended the proposal for expenditure for the contract services for watch and ward duty at CMFRI. The Committee also recommended the reappropriation of funds from equipment to furniture.

SCIENTIFIC ADVISORY COMMITTEE MEETING - KVK

The Fourth meeting of the reconstituted Scientific Advisory Committee of the KVK was convened on 18th August 2007 at CMFRI Headquarters, Cochin. Prof. (Dr.) Mohan Joseph Modayil, Director, CMFRI and Chairman, Scientific Advisory Committee presided over the meeting participated by Members including Dr. S. Prabhukumar, Zonal Coordinator, TOT Projects of ICAR, Zone VIII, Bangalore, Special invitees and Heads of Socio-Economic Evaluation & Technology Transfer Division, Finance & Accounts and Administration of CMFRI.

Participation of Scientists in conferences, meetings, workshops, symposia and training in India and abroad

Prof. (Dr.) Mohan Joseph Modayil, Director participated in the following meetings

Fourth Indian Fisheries Science Congress at Patna and delivered a key note address (12th and 13th April, 2007).

Chaired the Fourth Meeting of X IJSC of CMFRI at Tuticorin R.C. of CMFRI (9th May, 2007).

Chaired the fisherfolks awareness campaign in connection with CMFRI Diamond Jubilee year (17th May, 2007) at Chethi.

Meeting of the Tenth plan proposed works, HRD in XI plan and related matters at S.V.Veterinary University, Tirupati (9th and 10th June, 2007).

Inaugural ceremony of ICAR Foundation Day (16th July, 2007).

Director's Conference at ICAR, New Delhi (17th and 18th July, 2007).

Review meeting with Additional Secretary DARE & Secretary, ICAR at CRIJAF, Kolkatha (2nd and 3rd August, 2007).

Inaugurated the Aseethi in the Zoology Seminar Hall of St. Berchaman's College, Changanassery (5th September, 2007).

Inaugural programme of the FAO Expert Workshop on "Use of wild fish as feed for Aquaculture" being organized in collaboration with MPEDA at The Avenue Regent, Ernakulam (16th November, 2007).

Dr. N.G.K. Pillai, Director participated in the following meetings

XXI Meeting of ICAR Regional Committee No. VIII at CTCRI, Thiruvananthapuram on (11th and 12th January, 2008).

Governing Body Meeting of NFDB chaired by Shri Sharad Pawarji, Hon'ble Union Minister for Agriculture held at CMFRI, Cochin (5th January, 2008).

Assessment Committee Meeting at ASRB, New Delhi (14th -18th January, 2008).

Inaugurated the Seminar on "Coastal Zone Management and Poverty Alleviation" at Pathirappally (29th January, 2008).

Presented the XI Plan Proposal in the EFC meeting chaired by the Director General, ICAR at ICAR, Krishi Bhavan, New Delhi (4th February, 2008).

Felicitation address in the inaugural function of the two-day International Seminar on Ornamental fishes held at Cochin (2-3 February, 2008).

Felicitation address in the one day seminar on 'Ornamental Fish' in connection with IndAquaria-08 at Hotel Avenue Centre, Kochi (6th February, 2008).

Presided over the valedictory function of the ICAR sponsored Winter School on "Impact of Climate Change on Indian Marine Fisheries (7th February, 2008).

Inaugural function of the 16th India International Seafood show (IISS 2008), a biennial event organized by the Marine Products Export Development Authority (MPEDA) in association with the Seafood Exporters Association of India (SEAI) at Hotel Le Meridien, Kochi (8th February, 2008).

As Chief Guest, delivered the 14th Devidas Menon Endowment Lecture on "Fish Production Trends from Coastal Waters of India; Approaches towards Sustainable Exploitation" at College of Fisheries, Kerala Agriculture University Panangad (14th February, 2008).

Valedictory function of the Diamond Jubilee Celebration of Tuticorin Research Centre of CMFRI and launched a community based pearl production through village-linked programme (19th February, 2008).

Chaired the NAIP Expert Consultation on 'Oceanic tuna fishing in Lakshadweep sea – a value chain approach' and EFC meeting convened by DDG (Fy) (24th -27th February, 2008).

Meeting convened by DDG, ICAR to discuss on XI Plan EFC of CMFRI, PMC meeting of NAIP and also XI Plan EFC Meeting chaired by DG, ICAR (2nd -5th March, 2008).

Chaired the Xth IJSC meeting at CMFRI, Cochin (10th March, 2008).

Chaired the 15th SRC meeting held at CMFRI Headquarters, Cochin (14th to 19th March 2008).

Presided over the inaugural function of the Seminar on 'Marine Fisheries in India – present status and future direction' conducted at Madras Research Centre in connection with the Diamond Jubilee celebrations of the Madras Research Centre of CMFRI, Chennai and delivered a talk on 'Production trends from coastal waters of India – an approach towards sustainability' (25th March, 2008).

Chaired the 66th Institute Management Committee meeting of CMFRI (27th March, 2008).

Scientists of the Institute participated in the following conferences, meetings, workshops, symposia and training programmes

Dr. E. Vivekanandan participated and presented country paper "Status of shark fisheries in India" in the Regional Consultative Meeting on Evolving Management Plans for Shark Fisheries organized by the Bay of Bengal Programme - Inter-Governmental Organization (BOBP-IGO) at Beruwala, Sri Lanka during March 24-26, 2008. The meeting was attended by representatives from Fishery Survey of India and DAHD & F, and from Maldives and Sri Lanka. The purpose of the meeting was to review the status of shark fisheries in the Bay of Bengal including its socio-economic aspects and to suggest management options for sustainable shark fisheries.

Local Steering Committee Review Meeting of the 8th Asian Fisheries Forum held under the Chairmanship of Prof. Abdul Azis, Vice Chancellor, CUSAT (9th April, 2007) - ***Dr.R. Sathiadhas***

Seminar by Dr. T.V. Sathianandan on 'Simulation modeling for fishery management – An approach using surplus production model and genetic algorithm' organized by the Fishery Resources Assessment Division, CMFRI (11th April, 2007) - ***All staff of CMFRI Headquarters, Cochin***

Action Plan Meeting of KVKs of Kerala State and Lakshadweep, at Mannuthy, Kerala Agricultural University, Trichur on 12th and 13th April 2007. ***Dr.K.Asokakumaran Unnithan, Dr. P. M. Aboobaker***

Preparation of guidelines for Mariculture for National Fishery Development Board (7-9 May, 2007). -***Dr. R. Paul Raj***

Trawl Ban Committee Meeting convened by the Hon'ble Minister in Assembly Complex, Thiruvananthapuram (28th March 2007) - ***Dr.R.Sathiadhas***

21 days CAS Training Programme on 'Nutritional Strategies and Feeding Management in Finfish and Shellfish' organized by the Central Institute of Fisheries Education, Mumbai (29th March – 18th April, 2007) - ***Dr. Kajal Chakraborthy***

Public hearing of stakeholders held at Dist. Panchayat Office, Kollam as members of the Trawl Ban Committee in its 1st sitting (4th April 2007) - ***Dr.R. Sathiadhas and Dr. N.G.K Pillai***

Public hearing of stakeholders held at IFP, Cochin as member of the Trawl Ban Committee in its II nd sitting (7th April 2007) - ***Dr.R. Sathiadhas***

Site selection at Mangalore for the permanent establishment of Mangalore Res. Centre of CMFRI (10th April 2007 to 12th April 2007) - ***Dr.R. Sathiadhas***

Trawl Ban Committee Meeting convened by the Hon'ble Minister in Assembly Complex, Thiruvananthapuram (13th April, 2007) - ***Dr.R. Sathiadhas***

Workshop on "Use of Ecopath with Ecosim software for trophic modelling of marine ecosystem" at TRC of CMFRI, Tuticorin (18th – 21st April, 2007). -***Dr. E. M. Abdussamad***

Trawl Ban Committee Meeting at IFP, Cochin (25th April 2007) - ***Dr.R. Sathiadhas, Dr. N.G.K. Pillai and Dr. E.V.R. Radhakrishnan***

Workshop on trophic modelling and ecosystem analysis at Kochi (26th to 28 April, 2007) -***Dr. M. Sivadas***

Task force meeting of the Department of Biotechnology, for presentation of the project proposal (17th May, 2007) -***Dr. P.C. Thomas and Dr. P. Jayasankar***

Institute Management Committee Meeting at CIFT, Cochin (21st May, 2007) - ***Dr.R. Sathiadhas***

NAIP Consortium Partners Meeting at CMFRI, Kochi (24th May, 2007) - ***Dr. N.G.K. Pillai and Shri K. P. Said Koya***

NAIP Stakeholders Workshop on the project 'Oceanic tuna and squid fisheries in the Andaman and Lakshadweep seas: A value chain approach' organized by CMFRI, Cochin (28-29 May, 2007) – ***Dr. N. G.K. Pillai, Dr. E.V. Radhakrishnan Dr. R. Sathiadhas Dr. P. Jayasankar, Shri K. P. Said Koya and Smt. U. Ganga***

First-Training-cum-Workshop on IP and Technology Management in ICAR system (28-30 May, 2007) -***Dr. Kajal Chakraborthy***

Orientation Programme in Hindi for the Heads of the member offices of TOLIC, Calicut held at Hotel Span, Calicut (30th May, 2007) - ***Dr. P.N. Radhakrishnan Nair***

National Seminar in Official Language on "Climate change and Fisheries" organized by CMFRI on 30th May 2007- ***Scientists of CMFRI***

39th Meeting of the TOLIC, Kozhikode held at Indian Institute of Management, Kozhikode (31st May, 2007) -***Dr. P.N. Radhakrishnan Nair***

One-day Workshop on documenting the achievements of KVKs in the X Plan period, held at Tamil Nadu Agricultural University, Coimbatore on 31st May, 2007. ***Dr. K. Asokakumaran Unnithan, Dr. P. M. Aboobaker***

Attended the Brain Storming Session on 'Primary Productivity and Fish Stock Assessment' using remote sensing at Kochi Base of Fishery Survey of India, Kochi (5th June, 2007) - ***Dr. K.S. Mohamed***

Fishermen Welfare Task Force Committee Meeting & Public hearing held at Trivandrum Press Club, Near Secretariat (7th June 2007) - ***Dr.R. Sathiadhas***

As a Member of the Local Advisory Committee of Regional Science Centre, Kozhikode attended its 15th Meeting held at RSC, Calicut (7th June, 2007) - ***Dr. P.N. Radhakrishnan Nair***

'Global warming and its impact on Indian fisheries' – Talk by Prof. (Dr.) C.K. Rajan, Hon. Director, Centre for Monsoon Studies, CUSAT at CMFRI, Cochin (8th June, 2007) – ***All staff of CMFRI Headquarters, Cochin***

As resource persons in the training programme on "Coastal Aquaculture" funded by NFDB and organized by KVK, Narakkal (11-21 June, 2007) - ***Dr. Imelda Joseph and Dr.K.S.Sobhana***

Trawl Ban Committee Meeting held at School of Industrial Fisheries, CUSAT (26th June, 2007) - ***Dr. R. Sathiadhas***

Awareness programme on 'Rural livelihood enhancement through community participation', organized by Rajeev Gandhi Chair in Contemporary studies, School of Environmental studies, CUSAT on 28th June, 2007. ***Shri B. Sureshkumar***

Fishermen Welfare Task Force Committee Meeting and public hearing held at IFP Conference Hall, Cochin (6th July, 2007) - ***Dr.R. Sathiadhas***

Attended a seminar given by Dr. A.C. Narayana, Professor of Marine Geology, CUSAT on 'Expedition to Antarctica – the land of ice cover', organized by the 'Ocean Society of India' at NIO, Cochin (10th July 2007) -***Dr. (Mrs.) Mary K. Manisseri, Dr. K. Vinod, Smt. T.S. Naomia and Shri N. K. Sanil***

Workshop on responsible fisheries conducted by SIFFS, Thiruvananthapuram (13-14 July, 2007) - ***Dr.C.Ramachandran***

Felicitation talk in connection with the observance of "Moon Landing Week" at Regional Science Centre, Calicut (20th July, 2007) - ***Dr. P.N. Radhakrishnan Nair***

Workshop on 'Scientific findings of the MLR Project on Marine Mammals of India' of Ministry of Earth Sciences -'Studies on marine mammals of Indian EEZ and the Contiguous seas' organized by CMFRI at Cochin (25th July, 2007) -***Dr. K.S. Mohamed, Dr. P. Jayasankar and Shri K. P. Said Koya***

Final Workshop of the Ministry of Earth Sciences-funded project "Studies on marine mammals from the Indian EEZ and the contiguous seas" (25th July, 2007) -

As resource persons in the training programme on "Coastal Aquaculture (Farming system involving finfish/ shellfish/seaweed, agriculture & livelistock)" funded by NFDB and organized by KVK, Narakkal (25th July to 4th August, 2007) - ***Dr. E.V. Radhakrishnan, Dr. K.S.Sobhana and Dr. Imelda Joseph***

Environmental Laws and Jurisprudence – Indian Scenario – talk by Prof. (Dr.) P. Leelakrishnan, Former Dean, Faculty of Law, CUSAT, Thrikkakara at CMFRI, Cochin (3rd August, 2007) - ***All staff of CMFRI Headquarters, Cochin***

Attended the AMAAS South Zone meeting at IISR, Calicut (3-4 August, 2007) -***Dr. Imelda Joseph***

IMPCC Meeting as per Directors nomination Sree Chitra Tirunal Institute of Medical Sciences and Technology, Trivandrum and presented extension activities of CMFRI (10th August, 2007) -***Dr.R. Sathiadhas***

Seminar by Prof. Alexander John, Department of Community Medicine, Amritha University, Ernakulam on 'Environment and Health' at CMFRI , Cochin (17th August 2007) – ***All staff of CMFRI Headquarters, Cochin***

Attended the Advisory Committee Meeting of the KVK at CMFRI, Cochin (18th August 2007) -***Dr.R. Sathiadhas***

Formulation of Network project on Fish Nutrition for the XI plan period at ICAR, New Delhi (21-22 August, 2007) - ***Dr. R. Paul Raj***

Fishermen Welfare Task Force Committee Meeting held at IFP Conference Hall, Cochin (22nd August, 2007) - ***Dr.R. Sathiadhas***

One-day Workshop organized by the National Fisheries Development Board and Zonal Coordinating Unit, TOT Projects, Bangalore at Krishi Vigyan Kendra, Pondicherry on 25th August, 2007. ***Dr. K. Asokakumaran Unnithan***

EFC meeting with the DDG(Fy), ICAR, New Delhi (27th and 28th August, 2007) - ***Dr.R. Sathiadhas***

Third meeting of the Scientific Advisory Committee on Marine Living Resources programme (SAC-MLRP) at Cochin (31st August, 2007) - ***Dr. K.S. Mohamed***

ICAR-NACA Workshop on "Aquatic epidemiology, surveillance and emergency preparedness" at CIBA, Chennai (3-7 September, 2007) - ***Dr. K.S.Sobhana***

Official Language Implementation Committee quarterly meeting of the Institute (7th September, 2007) - ***Dr. E.V. Radhakrishnan and Dr. K.S. Mohamed***

Training programme under '*Tsunami* Emergency Assistance Project' implemented by Matsyafed, Govt. of Kerala at Kochangadi in Ernakulam District during 10-13 September 2007 as a member of the faculty. ***Smt. P. Sreeletha***

Challenges for ensuring contribution of fish to nutritional and livelihood security; a talk by Dr.M.V. Gupta, Former Assistant Director General, International Relations and Partnerships, World Fish Centre and World Food Prize Laureate 2005 on at CMFRI, Cochin (19th September 2007) - ***All staff of CMFRI Headquarters, Cochin***

Seminar by Dr. Kajal Chakraborty on 'IP and Technology Management in ICAR system' at CMFRI, Cochin (24th September, 2007) - ***All staff of CMFRI Headquarters, Cochin***

Aqua India 2007 organized by the Society of Aquaculture Professionals (SAP), at Chennai (28-29 September, 2007) - ***Dr. K.K. Vijayan***

Field Day at Mookkannur, near Angamaly in connection with the Front Line Demonstration of Tissue culture banana cultivation on 5th October 2007. ***Dr.K.Asokakumaran Unnithan, Shri B. Sureshkumar, Shri.V.K.Suresh***

Orientation programme of Agricultural Technology Management Agency (ATMA) conducted by the Department of Agriculture at Ernakulam during 8-9 October 2007. ***Dr. P. M. Aboobaker, Shri B. Sureshkumar***

Task Force meeting and made a presentation on the project entitled "Development and application of CMG family Recombinant hormones, their antagonists and RNAi technique for induced maturation and spawning of *Penaeus monodon"* (10-11 October, 2007) - ***Dr. K.K. Vijayan***

Winter School on "Bioprocess technologies in utilization of agricultural residues for production of enzymes and biofuels" at the Central Institute of Post-Harvest Engineering & Technology (CIPHET), Ludhiana, Punjab (16th October to 5th November, 2007) - ***Dr. Imelda Joseph***

Seminar by Dr.K.K. Vijayan on 'Development of diagnostic DNA microarray for simultaneous detection of multiple viral pathogens affecting aquaculture finfish and shellfish' at CMFRI, Cochin (17th October, 2007) - ***All staff of CMFRI Headquarters, Cochin***

Success of Mussel & Oyster Farming - Programme organized by Molluscan Fisheries Division at CMFRI, Cochin (18th October, 2007) - ***All staff of CMFRI Headquarters, Cochin***

Meeting in connection with watershed development at District Agricultural Office, Kakkanadu on 19th October 2007. ***Dr.K.Asokakumaran Unnithan***

Seminar on 'Mushroom Cultivation' organized by the Ernakulam elfare Service Society at Ponnurunny, Ernakulam on 25th October 2007. ***Shri B. Sureshkumar***

Annual Review Meeting of the KVKs of Zone VIII held during 29th October to 01st November 2007 at Dindigul, Tamil Nadu. ***Dr.K.Asokakumaran Unnithan***

Meeting of the Board of Studies in Industrial Fisheries, CUSAT in the Syndicate Hall of the University Administrative Building, Cochin (31st October, 2007) - ***Dr.R. Sathiadhas***

Seminar on 'Organic Farming' organized by Jana Sevana Charitable Trust at Kalloorkadu, Ernakulam on 3rd November 2007. ***Shri B. Sureshkumar***

Public Interaction Campaign named as 'Bharat Nirman', organized by the Press Information Bureau, Ernakulam during 3-7 November 2007 at Edathala, near Alwáye in Ernakulam district. ***Shri B. Sureshkumar***

Seminar by Prof. C.S. Paulose, Director, Centre for Neuroscience, CUSAT on 'Biotechnology today and tomorrow' at CMFRI, Cochin (7th November, 2007) - ***All staff of CMFRI Headquarters, Cochin***

Winter school entitled "WTA, GATS, and IPR: Implications in Agricultural Research and Education" at NAARM, Hyderabad (14th November – 4th December, 2007) - ***Dr. Kajal Chakraborty***

Particiapted in the workshop on Environment management reform for sustainable farming, fisheries and aquaculture at Cochin on 16th November, 2007 organised by CUSAT - ***Dr. E.V. Radhakrishnan***

One day National Level Consultation workshop on Environmental Management Reform for Sustainable Aquaculture and Fisheries (AquAgris) and release of the Book 'Sustain Fish' by Shri S. Sharma, Hon'ble Minister for Fisheries and Registration, Govt. of Kerala at International Hotel, Cochin (16th November, 2007) - ***Dr. N.G.K. Pillai, Dr.R. Sathiadhas, Dr. K.S. Mohamed and Dr. K.K. Vijayan***

8th Asian Fisheries Forum held at Kochi. (20th- 23rd November, 2007) - ***All scientists of CMFRI***.

Atended a meeting at MPEDA on seafood certification on 26th November, 2007 - ***Dr. E.V. Radhakrishnan***

Inauguration of the fish farmers training programme organized by BFFDA at Thuravoor on 28th November 2007. ***Dr.K.Asokakumaran Unnithan***

Delivered a lecture in the Winter School on 'Biodiversity and Stock Assessment Methods for Fisheries Professionals' at Tuticorin organized by Tamil Nadu Veterinary & Animal Science University, Tuticorin. (28th and 29th November, 2007) - ***Dr. K.S. Mohamed***

IMPCC Meeting as per Directors nomination at the All India Radio Conference Hall, Trivandrum and presented extension activities of CMFRI (29th November, 2007) - ***Dr.R. Sathiadhas***

Meeting of the Board of Studies in Industrial Fisheries, CUSAT in the Syndicate Hall of the University Administrative Building, Cochin (4th December, 2007) - ***Dr.R. Sathiadhas***

Attended the TAG-2 meeting of NAIP and presented the revised project proposal 'Oceanic tuna fisheries in Lakshadweep seas: a value chain approach' for NAIP funding on 9th - 12th December, 2007 at New Delhi - ***Dr. E.V. Radhakrishnan***

44th Task Force Committee meeting of the STED Project held in the chamber of the District Collector, Calicut (14th December, 2007) -***Dr. P.N. Radhakrishnan Nai***r

40th meeting of the TOLIC, Calicut held at Hotel Asma Tower, Calicut (17th December, 2007) - ***Dr. P.N. Radhakrishnan Nair***

Mahila Meet on drudgery reduction using hay box organized by the KVK in association with Kottapuram Integrated Development Society on 17th December 2007 at Chettikadu near North Parur, Ernakulam District. ***Smt. P. Sreeletha***

State Level Seminar on vegetable cultivation organized by the National Horticultural Research Institute and KVKs of Dindigul and Karur during 20-21 December 2007 at Trichy. ***Shri B. Sureshkumar***

Scientific Advisory Committee Meeting of Trichur KVK at Vellanikkara, Trichur on 21st December, 2007 ***Shri. J. Narayanaswamy***

Seminar on value addition of fish organized in connection with South Indian Agricultural Fair–2007 at Mannuthy on 30th December 2007. ***Dr.K.Asokakumaran Unnithan, Smt. P. Sreeletha, Shri.V.K.Suresh***

The 94th Indian Science Congress in Andhra University, Visakhapatnam (3-7 January, 2008) - ***Dr. Kajal Chakraborthy***

International consulting Workshop on "Microbial & enzymatic Technology in Aquaculture: Scope for mutual co-operation with Indian Research Institutes and consultants" at Bangalore (7th January, 2008) -***Dr. K.K. Vijayan***

Meeting organized by the Residents Association of Mooleppadam Housing Colony at Kalamasserry on 10th January 2008. ***Dr.K.Asokakumaran Unnithan, Smt. P. Sreeletha***

Official Language Implementation Committee quarterly meeting of the Institute on (10th January, 2008) - ***Dr. K.S. Mohamed and Dr. E.V. Radhakrishnan***

Executive Committee meeting of the Central Government Employee's Welfare Coordination committee, Calicut held at Income Tax Office, Calicut (14th January, 2008) - ***Dr. P.N. Radhakrishnan Nair***

As resource person delivered lectures on "Diseases in ocean ecosystem and their dynamics in relation to climate change" and "Relevance of disease management with special reference to sustainable fisheries and mariculture" for the Winter School on "Impact of climate change on Indian Marine Fisheries" organized by CMFRI (18th January to 7th February, 2008) - ***Dr. K.K. Vijayan***

Farmers' Meet organized jointly by the KVK and Vegetable and Fruit Promotion Council, Ernakulam, at Mookkannur on 30th January 2008. ***Shri B. Sureshkumar, Shri.V.K.Suresh***

Attended and made presentation in the International Seminar on Ornamental Fish Breeding, Farming and Trade at Cochin (2-3 February, 2008) -***Dr. K.K. Vijayan and Dr. E.V. Radhakrishnan***

Two-day training programme on mud crab farming organized by the Marine Products Export Development Authority on 4th and 5th February, 2008 at Nayarambalam in Vypeen Island. ***Dr. K. Asokakumaran Unnithan***

Presented a paper in the International Conference on Biodiversity Conservation and Management *BIOCAM* 2008, Cochin (3-6 February, 2008) - ***Dr. Imelda Joseph***

Meeting at Export Inspection Agency, Kochi to discuss the modalities for introducing official control on primary production and relaying areas of bivalve molluscs as specified in the GOI Notification and also a visit to an identified production area of bivalve mollusks (14th and 15th February, 2008) - ***Dr. K.S. Mohamed***

One day farmers' Seminar on 'Diversification in coastal aquaculture' organized by the MPEDA at Nayarambalam on 14th February 2008. ***Dr.K.Asokakumaran Unnithan, Shri.V.K.Suresh***

Imparted training as the Technical Expert to 14 Senior Executives of the HSBC Bank from various countries on 'Next generation challenges in India' organized by the LEAD International and BNHS and presented a paper on 'Lakshadweep tuna fisheries – Prospects and Problems' at Hotel International, Cochin (18th February, 2008) - ***Shri K.P. Said Koya***

Training Workshop on Capacity Building on IP Management and Technology Licensing in Agriculture at the Kerala Agricultural University, Mannuthy, Kerala conducted by the IPR Cell, Directorate of HRM, CCS Haryana Agricultural University, Hissar (18-20 February, 2008) - ***Dr. K.S. Mohamed***

Meeting of the Task Force on Resource assessment of deep sea fishes of the continental slope and central Indian ocean convened by Centre for Marine Living Resources and Ecology (CMLRE) (21st February, 2008) - ***Smt. U. Ganga***

As resource person in the training programme on "Coastal Aquaculture (Farming system involving finfish/shellfish/ seaweed, agriculture & livelistock)" funded by NFDB and organized by KVK, Narakkal (22nd February to 4th March, 2008) - ***Dr. K.K. Vijayan***

Organized a Workshop on 'Trophic modeling, NWC and GOM ecosystems, fishery simulations' and discussions with the Project Associates at Mumbai RC (24th to 29th February, 2008) - ***Dr. K.S. Mohamed, Dr. E.V. Vivekanandan, Dr. P.U. Zachariah, Dr. P.K. Ashokan.***

Attended PMC meeting of NAIP from 24th February, 2008 at New Delhi - ***Dr. E.V. Radhakrishnan***

Presided over the function organized by Regional Science Centre, Calicut to observe the National Science Day (28th February, 2008) - ***Dr. P.N. Radhakrishnan Nair***

Meeting of the Task Force on Assessment of myctophid resources convened by Centre for Marine Living Resources and Ecology (CMLRE) (28th February, 2008) - ***Smt. U. Ganga***

Meeting of Task Force on Mariculture MLR programme at CMLRE (4th March, 2008) - ***Dr. K.S. Mohamed, Dr. V. Kripa.***

Meeting of Green Mussel Farming, Processing and Marketing Co-op. Society at Kasargode (5th March 2008) -***Dr. K.S. Mohamed***

Attended Scientific Seminar in Hindi at Heavy Water Plant, Tuticorin (5th and 6th March, 2008) - ***Dr. E. M. Abdussamad***

15th Staff Research Council (SRC) meeting held at CMFRI headquarters, Cochin (14-19 March, 2008) **– *All scientists of CMFRI***

Task force meeting of the Department of Biotechnology, New Delhi and presented the project proposal on "Establishment and characterization of cell lines from the rabbit fish, *Siganus canaliculatus* and the marine ornamental fish, *Dascyllus trimaculatus"* (17th March, 2008) - ***Dr. K.S. Sobhana***

Inaugural function of the one-day training course on mussel culture organized by the Department of Fisheries, Govt. of Kerala at Azhikode on 18th March 2008. ***Dr. P. M. Aboobaker***

Jasmine farmers' Meet at Vengola near Perumbavoor on 22nd March 2008 as a part of the On Farm Testing programme of application of biocontrol agents against root rot disease of jasmine. ***Dr.K.Asokakumaran Unnithan***

One day National Workshop on Agricultural Biosecurity at NASC Complex, Delhi and made a presentation on "Biosecurity issues with special reference to mariculture development in India" (25th March 2008). - ***Dr. K.K. Vijayan***

Seminar on 'Marine fisheries research in India: present status and future direction' organized by the Madras Research Centre of CMFRI in connection with the Diamond Jubilee celebrations of CMFRI (25th and 26th March, 2008) - ***Dr. E.V. Radhakrishnan, Dr. K.S. Mohamed, Dr. K.K. Vijayan, Dr. J. Jayasankar, Dr. V. Kripa and Smt. S. Lakshmi Pillai***

As resource person in the NFDB training programme organized by BFFDA at Fisheries Training Centre (NIFAM) Aluva (31st March, 2008) - ***Dr. K.K. Vijayan***

Personnel
(Senior positions only)

Director	Prof. (Dr.) Mohan Joseph Modayil (until 07 December 2007) Dr. N.G.K. Pillai (from 08 December 2008)
Heads of Divisions	
Fishery Resources Assessment Division	Dr. M. Srinath
Pelagic Fisheries Division	Dr. N. Gopalakrishna Pillai
Demersal Fisheries Division	Dr. E. Vivekanandan
Crustacean Fisheries Division	Dr. E.V. Radhakrishnan
Molluscan Fisheries Division	Dr. K.Sunilkumar Mohamed
Fishery Environment Management Division	Dr. M. Rajagopalan / Dr. A. Laxminarayana
Physiology, Nutrition and Pathology Division	Dr. K.K. Vijayan
Socio-Economic Evaluation & Technology Transfer Division	Dr. R. Sathiadhas
Marine Biodiversity Division	Dr. (Mrs.) Rani Mary George / Dr. (Mrs.) Mary K. Manisseri
Mariculture Division	Dr. G. Gopakumar
Sr. Administrative Officer	Shri. K. L. Meena / Smt. Roja Sethumadhavan
Sr. Finance & Accounts Officer	Shri. G. P. Sharma / Shri. Kunthia
Scientists-in-Charge of Regional/Research Centres	
Mandapam Camp	Dr. G. Gopakumar, PS
Chennai	Dr. H. Mohamed Kasim, PS
Tuticorin	Dr. P. Muthiah, PS
Karwar	Dr. V.S. Kakati, PS
Mangalore	Dr. C. Muthiah, PS / Dr. A.P. Dinesh Babu, Sr. Scientist
Veraval	Dr. G. Mohan Raj, PS
Vizhinjam	Smt. Grace Mathew, PS / Dr. (Mrs.) Rani Mary George
Mumbai	Dr.V.D. Deshmukh, PS
Visakhapatnam	Dr. G. Syda Rao, PS
Calicut	Dr. P.N. Radhakrishnan Nair, PS
Krishi Vigyan Kendra, Narakkal	Dr. Ashoka Kumaran Unnithan, Sr. Scientist

Official Language Implementation Activities for the year 2007-2008

A gist of Implementation activities of the year is given below.

I. Policywise ensurance

a) Correspondence and bilingualisation programmes to run the machinery in Hindi.

A gist of implementation activities carried out during the year is given below.

1. **Ensurance of basic guidelines**

a) The Official Language Implementation Committee meetings and the reviews for improvement.

During the year, the 72nd to 74th series of Official Language Implementation Committee meetings were held. The committee plays a pivotal role in chalking out plans and implementing the decisions. Check points have been fixed at responsible level and circulated. The implementation activities of 10 Centres were reviewed and necessary policy suggestions were given for improvement.

b) Targets of correspondence and bilingualisation programmes.

Bilingual cent percent issue of Section 3(3) documents (nos.1365); reply of letters received in Hindi (314 nos.); target on Hindi correspondence (70% against the target of 55%) ensured.

Under ensurance of bilingualisation of stationery items and the similar 128 rubber stamps/name plates renewed; 147 museum labels prepared; 18 identity cards renewed; 7 plaques and 3 invitation cards prepared; 38 certificates and 64 charts/ maps prepared; 23 standard drafts each to Karwar, Vizhinjam, Madras and Bombay Centres issued; 1 standard form on ARS added to the LAN; Installed Hindi software ***Leap Office*** in the computers of Headquarters and 6 Centres on demand.

c) Inspections for ensurance

1) Policywise inspection letter issued to Visakhapatnam Regional Centre on Directors inspection held on 14th March 2007. 2) DARE inspected CMFRI Headquarters on 30th May 2007 and recorded satisfactory note. 3) Mandapam Centre was inspected by ICAR inspection team on 12th July 2007. 4) The Assistant Director (OL) inspected the Headquarter's various cells and premises and gave suggestions for improvement (22nd December 2007).

II. HRD programmes enabling to work themselves in Hindi

a) By the maintenance of roster on working knowledge and deputation, 5 employees passed the course Pragya.

b) To acquaint with the craft of using Hindi, Hindi workshops were organized at Headquarters for ministerial staff on 27th April 2007; ministerial officers and staff on 27th and 28th November 2007; ministerial staff of outstations (19th February 2008 - Leap Office); Technical Officers and staff (5th March 2008 - Leap Office). Hindi workshops were also organized at Veraval, Tuticorin, Mumbai and Mangalore Centres.

c) Under the programme *learn a word a day*, 284 Hindi words were displayed *on line* and *on board*

d) The special incentive scheme continued; 12 persons won the cash awards. During the year, at par with Headquarters, Mangalore and Calicut Centres introduced special incentive scheme.

Chief Guest Shri. C. Rajendran, Income Tax Ombudsman, Kochi addressing the staff members during the Hindi Chethana Mass - 2007

Dr. P.K. Agarwal, National Co-ordinator, ICAR Network Project on Climate Change releasing the Special Hindi Publication on Climate Change and Fisheries

III. Extension programmes to disseminate

a) Hindi Chethana Maas

The Hindi Chethana Mass was observed at the Institute during 1-28 September 2007 with awareness Cultural and Solidarity programmes. On the valedictory function on 28th September 2007, notable contributors and winners of programmes were felicitated with mementos/prizes.

- Hindi Day/Week was also observed at all Regional / Research Centres.

b) Scientific Seminar

In order to disseminate the scientific knowledge by conversing and recording, a Seminar was organized on the topic '**Climate Change and Fisheries'**. In this national Seminar, 13 papers were presented in Hindi and the proceedings were released.

c) Popular articles

Four technical articles on the following subject were edited & forwarded

- Future of sea farming
- Impact of carbon deposit on global climate
- Importance of *Vibrio parahaemoliticus* in seafood.
- Rich marine biodiversity of India and its conservation.

IV. Education

a) Four Research Abstracts of M.F.Sc./Ph.D. students were prepared in Hindi.

b) A book in Hindi on Fisheries for higher education was published.

Title of book - *Bharat mei Matsyaki Aur Jalkrishi ka vikhas*
Authors - *Dr. N.G.K Pillai and Dr. Pradeep K. Katiha*

No. of pages - 247
Cost of book - 500/-

V. Library service

The target on purchase of Hindi books was ensured by purchasing books costing Rs.46,107/-. Popular/Departmental periodicals and newspapers are maintained.

VI. Press and editorial for the development of functional Hindi literature.

a) Quarterly periodicals in bilingual

- MFIS – Issues 190,191 & 192
- Newsletter – Issues 113,114 & 115

b) Special publications in Hindi

- Matsyagandha 2006
- Climate Change and Fisheries

c) Book in Hindi

- Bharat Mei Matsyiki Aur Jalkrishi ka vikhas

d) Wall magazine

- January & March issues displayed.

e) Annual report 2006-07 with Hindi executive summary.

VII. e-governance programmes for faster, cheaper spread

- On line display of todays word
- LAN facility of bilingual standard drafts and forms
- Dak and dispatch software *avagaman* to track database on correspondence.
- Web display of advertisements / announcements.

New initiatives

- The introduction of bilingual work programme on resource assessment to field staff in liason with FRA Division has increased the use of Hindi manifold.
- Wall magazine to educate is slowly catching the eyes of all.

Awards

CMFRI Headquarters and Mangalore Research Centre won best implementation award from the TOLIC concerned.

Distinguished Visitors

Hon'ble Union Minister Shri. Sharad Pawar and Smt. Prathiba Pawar at CMFRI, Cochin

Shri. M.B. Prasad, Minster of Fisheries, Andhra Pradesh viewing the cage farming exhbit

Guests

Headquarters, Cochin

- Shri Sharad Pawar, Hon'ble Union Minister for Agriculture, Consumer Affairs, Food & Public Distribution, Government of India and President, ICAR, and Smt. Prathibha Pawar.
- Dr. Mangala Rai, Secretary, DARE and Director General (Fy.), ICAR.
- Dr S Ayyappan, Deputy Director General, ICAR.
- Prof. (Dr.) Mohan Joseph Modayil, Member, Agriculture Scientists Recruitment Board.
- Shri S. Sharma, Minister for Fisheries, Government of Kerala.
- Fisheries Ministers from different states of the country.
- Mrs. Mercy Williams, Mayor, Cochin.
- Dr. Sebastian Paul, MP.
- Prof. K.V. Thomas, MLA.
- Mr. Stein Tveite, Skarpnesveien 58, 4823 Nedenes, Norway.
- Mrs. Rema Radhakrishnan, Clifton Terrace , Calicut.
- Dr. Y.S. Yadava, BOBP programme.
- Farmers, students from various schools and colleges, entrepreneurs and the general public visited ATIC, Marine Aquarium and the Marine Biodiversity Referral Museum of the Institute.

Mandapam Regional Centre

- Dr. C. D. Mayee, Chairman, Agriculture Scientists Recruitment Board, New Delhi.
- Dr. C. N. Pandey, Chief Conservator of Forests & Director, GEER Foundation Gandhi Nagar, Gujarat.
- Prof. (Dr.) N. R. Menon, Emeritus Professor, CUSAT & Hon. Scientist, Ministry of Earth Sciences, Cochin.
- Dr. Pushpito K. Ghosh, Director, CSMCRI, Bhavnagar.
- Dr. N. K. Narang, FA (DS), Ministry of Defence.
- Dr. K. R. Koundal, Joint Director (Research), I.A.R.I., New Delhi.
- Shri Kirlosh Kumar, District Collector, Ramanathapuram.
- Shri Har Sahay Meena, I.A.S., Collector, Theni
- Students and faculty from various schools and colleges and the general public.

Veraval Regional Centre

- Students and faculty from various schools and colleges.

Visakhapatnam Regional Centre

- Shri Mandali Buddha Prasad, Hon'ble Minister for Animal Husbandry, Dairy and Fisheries, Govt. of Andhra Pradesh.
- Shri N. Narasimha Rao, Commissioner of Fisheries, Govt. of Andhra Pradesh.
- Dr. S. Ayyappan, DDG (Fy.), ICAR, New Delhi
- 38 Fisheries extension officers as part of their training programme at MANAGE.
- Students and faculty from various schools and colleges.

Inauguration of Brain storming session by Hon'ble Minister Shri. Mandali Buddha Prasad

Mangalore Research Centre

- Shri Venkatesh Salagrama, Director, Integrated Coastal Management, Kakinada, Andhra Pradesh.
- Shri R. Rajan, Assistant Director, MPEDA, Mangalore.
- Dr M. Jayashankara, Chairman, Department of Microbiology, P. G. Centre, Moodbidri.
- Shri A.R.V.V. Saseedaran, Chairman and staff, Matsyafed, Thiruvananthapuram.
- Shri S. Gunakar, Lecturer in Commerce, Commerce Pompai College, Aikala, Kinnigoli, Karnataka.
- Dr. R. Busnur R. Manjunatha, Professor, Mangalore University.
- Dr. R.M. Mridula, Asst. Professor, College of Fisheries, Mangalore.
- Shri Abhilash Philip, Project Manager, Population Sciences International, Kottara Chowki, Mangalore.
- Dr. S. Benegappa, Professor and Head, Department of Fisheries Development and Management, College of Fisheries, Mangalore.
- Smt. Anupama Pai, Census Co-Ordianator (NGO), PEARL, Pondicherry.
- Shri N.C. Shivaprakash, Instrumentation, IISE, Bangalore.
- Dr. B.R. Balagangadhara, CSO, KSPCB, Bangalore.
- Dr. S. Elain Apshara, Senior Scientist, CPCRI, Vittal.

Karwar Research Centre

- Hon'ble M.P., Shri Ananthkumar Hegde with fishermen, leaders and industrialists.
- Dr. M.K. Dev Roy and Dr. S. Kar, Zoological Survey of India, Kolkata.
- Dr. M.R. Abdar, K. Nano Patil College, Sangli, Maharashtra with students.

Calicut Research Centre

- Shri Pathak, BNP, Legal Advisor, ICAR, New Delhi visited the Marine Aquarium.
- Dr. M. Anandaraj, Project Co-ordinator, Spices, IISR, Calicut visited the Marine Aquarium.
- Capt. Deepti Shinde, Mumbai visited the Marine Aquarium.

- Shri Saravanan Raju, Scientist (S.S.), National Research Centre for Medicinal & Aromatic Plants, Anand, Gujarat.

Vizhinjam Research Centre

- Davide Neri, Dean, Polytechnique University of Moide, Ancona, Italy.
- Prof. K. Muthuchelian**,** Director, Centre for Biodiversity, M.K. University, Madurai.
- Guman Singh, Justice, Rajasthan High Court, Jaipur.
- Smt. Sheila Thomas, PS to Chief Minister of Kerala.
- Students from various schools and colleges and the general public visited the Marine Aquarium.

Tuticorin Research Centre

- Shri Mobeen Khan, Asst. Commandant, ICGS Naiki Devi, Tuticorin.
- Shri K.R. Suresh, Commander, Varuna.
- Dr. S. Lazarus, Chairman, IEASE, Nagercoil.
- Smt. Indra Krishnakumar, Chief Postmaster General, Tamil Nadu Circle, Chennai.
- Shri A. Annamalai, Postmaster General, Southern Region, Madurai.
- Shri V. Rajarajan, Director, Postal Training Centre, Madurai.
- Shri Elise Hagenbesges, Shri Omanda Falics and Shri Vicole Cappuccio, Juniata College, U.S.A.
- Dr. S.A. Karmaly, Dept. of Zoology, St. Xavier's College for Women, Aluva.
- Dr. Raman Veera Singh, Scientist (SS), NBFGR, Lucknow.
- Faculty and students from various schools and colleges.

Launching of the village-linked pearl farming programme by Minster of Fisheries, Smt. P. Geetha Jeevan, Tamil Nadu at Tuticorin

Chennai

- Dr. C.D. Mayee, Chairman, Agriculture Scientists Recruitment Board, New Delhi.
- Dr. Claude Boyd, Professor, Mrs. D. Dom, Dr. David V. Rouse and Mrs. Synthia Rouse from Auburn University, USA visited Kovalam Field Lab.
- Dr. M. Sakthivel, President, AFI.
- Dr. Muralidaran, Regional Co-ordinator, WWF
- Dr. Mrs. Pamila Sukumaran, Women Christian College.
- Smt. Kumuda, Teacher from Corporation School, Nemmeli, Smt. M. Supraja, Teacher from Brotherwood School and Smt. D. Immaculate, Teacher from St. Joseph Higher Secondary School visited Kovalam Field Lab.

Krishi Vigyan Kendra

- Shri.L. Rynjah, IAS, Senior Advisor, Planning Commission, New Delhi.
- Dr. V. V. Sadamate, Advisor, Planning Commission, New Delhi.

Diamond Jubilee Celebrations

As part of the year long Diamond Jubilee celebrations, all research divisions and Centres of CMFRI organized various programmes.

Demersal Fisheries Division

- Dr. S. Sivakami delivered a talk on **"Growth profile of demersal fisheries in India"** on 3rd April 2007.
- Dr. S. Ajmal Khan, Professor, Centre of Advance Studies in Marine Biology, Parangipettai delivered a talk on **"Marine benthos and their importance to fisheries"** on 12th April 2007. Dr. Ajmal Khan also gave a demonstration on the application of **"PRIMER software"** in fisheries research.

Fishery Resources Assessment Division

- Dr. T.V. Sathianandan delivered a talk on **"Simulation modeling for fishery management – An approach using surplus production model and genetic algorithm"** on 11th April 2007.
- A workshop on **"Modern Tools for Fish Stock Assessment"** was organized from 11th to 13th April 2007.
- A workshop-cum-Training on **"Skill Enhancement for Marine Fisheries Resources Data Collection"** was organized for the field staff of FRAD during 16th to 18th April 2007.
- General knowledge Quiz was organized for the staff of CMFRI.

Socio-cocnomic Evaluation and Technology Transfer Division

The division organised 2 training programmes in connection with the diamond jubilee celebrations. One training programme on **"Responsible Fisheries"** at Chethi in Alappuzha district on 17th May 2007 and another one on **"Environment friendly shrimp farming"** at Kaitharam in Ernakulam district on 19th May 2007. In addition to these, one day outreach programme on **"Self Help Groups & credit and finance"** at Arattupuzha in Alappuzha district on 17th September 2007 and another outreach programme on **"Mussel Farming"** at Cheriyakadavu in Ernakulam district on 27th September 2007 were also organized by the division during the diamond jubilee year.

Pelagic Fishereies Division

As part of the Diamond Jubilee Celebrations, Division of Pelagic Fisheries has conducted a series of programmes in the month of June 2007. An invited talk by Prof. (Dr.) C.K. Rajan, Director for Centre for Monsoon Studies, School of Industrial Fisheries, CUSAT, Kochi on the topic **"Global warming and its impact on Indian Fisheries"** was arranged on 8th June followed by a quiz programme on **"Marine Life"** was conducted on 23rd June for the Post Graduate students (M.Sc./M.F.Sc)/ Research Scholars of the concerned Colleges/ University Departments of Ernakulam city. Seven teams participated in the programme and the team consisting of Ms. Neeta Susan David and Ms. T. Mini, PGPM, CMFRI won the First Prize with a cash award of Rs. 2000/- followed by Mr. Ehil Maran and Ms. Remya S. from Panangad Fisheries College, Kerala Agricultural University (Second prize) with a cash award of Rs. 1500/- and the Third prize with a cash award of Rs. 1000/- was won by

Hon'ble Union Minister Shri. Sharad Pawar inaugurating the Diamond Jubilee Celebrations. On the dias are Shri. S. Sharma, Minister of Fisheries, Govt. of Kerala, Shri. Sebastian Paul, Member of Parliament and Dr. Mangala Rai, Director General, ICAR, besides other dignitaries

Farmers meet at Chethi

Invited talk by Prof. (Dr.) C.K. Rajan, Director, Centre for Monsoon Studies, School of Industrial Fisheries, CUSAT, Kochi.

Quiz competition on Marine Life conducted on 23rd June

Painting competition on Aquatic Life for high school students organized on 30th June.

Inauguration of seminar on "Environment and Fisheries at Govt. Vocational Higher Secondary School, Narakkal

Talk by Prof.(Dr.) P. Leelakrishnan, Former Dean, Faculty of Law, Cochin University of Science & Technology

Mr. Anoop. B and Mr. V.V. Afsal, Research Scholars, FEMD, CMFRI. On 30th June, painting competition on **"Aquatic Life"** for the high school students was organized. Students from various schools of Ernakulam city had participated and the First prize with a cash award of Rs. 1000/- was won by Kumari Mili S. Mohan, St. Joseph's C.G.H.S. School, Tripunithura, Second Prize with a cash award of Rs. 750/- was won by Kumari Athira Menon, St. Antony's H.S.School, Kacharipady, Ernakulam and Third Prize with a cash award of Rs. 500/- was won by Kumar T.P. Promod, Kendriya Vidhyalaya Port Trust School, Kochi.

Marine Biodiversity Division

- An Elocution Competition on **"Global Warming"** was organized for students of various Schools on 21st July 2007.
- A Quiz Programme was conducted on the theme **"Marine Biodiversity and Environment"** for Post Graduate Students and Research Scholars on 28th July 2007.
- Prof. (Dr.) N.R. Menon, Hon. Director, C-IMCOZ, CUSAT, gave a talk on **"Digitized Inventory of Marine Resources"** on 30th July 2007.

Fishery Environment Management Division

- Fishery Environment Management Division organized three programmes as part of the Diamond Jubilee Celebrations of CMFRI, Cochin. A talk by Prof.(Dr.) P. Leelakrishnan, Former Dean, Faculty of Law, Cochin University of Science & Technology, Thrikkakara on **"Environmental Laws and Jurisprudence - Indian Scenario"** was organized on 03rd August 2007 at CMFRI auditorium.
- The FEMD conducted a seminar on **"Environment and Fisheries"** at Govt. Vocational Higher Secondary School, Narakkal on 09th August 2007. Lectures were given by the Scientists of the Division and the Scientist-in-Charge, KVK, Narakkal. The students and teachers of the Vocational Higher Secondary School, Narakkal attended the Seminar. There was also a demonstration of the water and soil analysis techniques by the FEMD.
- FEMD also organized a talk by Prof (Dr.) Alexander John, Dept. of Community medicine, Amritha School of Medicine, Ernakulam on **"Environment and Health"** on 17th August 2007 at CMFRI Auditorium, Cochin

Crustacean Fisheries Division

- As a part of Diamond Jubilee Celebrations, the division organized a commemorative talk on **"Challenges for ensuring contribution of fish to nutritional and livelihood security"** by Dr. M.V. Gupta (Former Assistant Director General, International Relations and Partnerships, World Fish Center, Malaysia and World Food Prize Laureate) on 19th September, 2007.
- An Educational programme and exhibition on **"Marine life"** was conducted at Government High School, Elamkunnapuzha, Ernakulam District on 22nd September 2007.

Molluscan Fisheries Division

- In connection with the Diamond Jubilee Celebrations of CMFRI, Molluscan Fisheries Division organized one day seminar

"**Celebrating the success of mussel and oyster farming**" on 18th October 2007. The seminar was inaugurated by Dr. B. Madhusudhana Kurup, Fisheries Adviser to Govt. of Kerala. During the seminar the original developers of mussel and oyster farming technology, Dr. K.K. Appukuttan and Shri G.P.K. Achary were honoured by presenting a Ponnada. Shri G.S. Gul Mohamed, the country's first mussel farmer and Karshaka Shiromani awarder described his experiences and commemorated the help rendered by CMFRI for setting up demonstration farms.

- In the afternoon – a **round table discussion** was organized with mussel farmers and an action plan for sustainable development of mussel and oyster farming was chalked out.

Dr. Kurup honours Dr. K.K. Appukuttan and Shri G.P.K. Achary with Ponnada

Marine Biotechnology Division

As part of Diamond Jubilee Celebrations of CMFRI, a series of programmes had been conducted by the MBT Division during the month of November 2007.

- An invited talk by Prof. C.S. Paulose, Head, Department of Biotechnology, Cochin University of Science and Technology on the topic **"Biotechnology Today & Tomorrow"** on 7th November 2007.
- A one day workshop **"KNOW YOUR DNA"** conducted on 17th November 2007. Twenty six (26) students representing MES, Al-Ameen, St. Peters, Nirmala, Aquinas, St. Albert's and Maharaja's colleges from Ernakulam District had participated in the workshop. Talks on genomics and hands on practicals on DNA technology had been given to the participants. Individual DNA profiles of participants were generated and demonstrated.
- A **"Biotechnology Quiz"** was conducted on 30th November, six teams from different colleges/institutes offering biotechnology course participated in the quiz, which contained an admixture of basic and applied questions, testing their knowledge on historical and modern developments in genetics and biotechnology. First prize with a cash award of Rs.2000/- won by Mar Athanasius College, Kothamangalam, Second prize with a cash award of Rs.1500/- won by Al-Ameen college, Edathala, third prize with a cash award of Rs.1000/won by CMFRI/NBFGR and a consolation prize of Rs.200/- given to three teams. Director addressed the participants and distributed the cash award and certificates to the winners.

Workshop in progress


Participants in the Biotechnology Quiz

Mariculture Division

- A training programme was organized for the hatchery technicians & students on **"Isolation, Identification and culture of microalgae"** from 29th October to 3rd November 2007. The trainees were given stock culture of phytoplankton to initiate diversified work in this filed. Feed back were received from different hatcheries.
- **Fish farmers meet** – an interaction with fish farmers and scientists was organized on 18th December, 2007. About 37 farmers from in and around Cochin attended the function. The meet was inaugurated by Dr. N.G.K. Pillai, Director, CMFRI. Heads of various divisions and scientists of Mariuclture division interacted with the farmers

Inauguration of the farmers meet

Maricultue farmers interacting with Scientists

and cleared their doubts about various technical issues related to marine fish culture.

- A one day awareness programme for higher secondary students fro various schools around Cochin was conducted on 22nd January, 2008. 57 participants from 4 different schools attended the programme. The programme started with a introductory speech by Director, Dr. N.G.K. Pillai. Students were given lecture classes on marine ornamental fishes and industry, breeding and hatchery production of ornamental fishes, culture of various live feeds used in hatchery and also on the setting up of marine aquaria and its management. Students were given on hand practical experience on each of these subjects. All the scientists of mariculture division participated in the programme by giving lectures and arranging practical in their respective fields.

Diamond Jubilee celebrations at various centers of CMFRI

Mangalore Research Centre of CMFRI

- Dr. A.C. Dinesh, Senior Geologist, Geological Survey of India delivered a talk on the **"Nature and causes for the occurrence of Tsunami"** on 28th February 2007.
- A painting competition on **"Life by the sea"** and **"Sea life"** and an Essay-writing competition was organized for the school students in July 2007.
- A quiz competition was conducted for high school students on 15th August 2007.

Madras Research Centre of CMFRI

- Seminar on **"Marine fisheries research in India: present status and future direction"** organized by the Madras Research Centre of CMFRI in connection with the Diamond Jubilee celebrations

Visakhapatnam Regional Centre of CMFRI

- An open house was arranged for the public on 3rd February 2007.

Tuticorin Research Centre of CMFRI

- A two days open house and exhibition was organized by the Tuticorin Research Centre of CMFRI on 19th & 20th February 2008 as a part of the diamond jubilee celebrations. The event was inaugurated by Smt. P. Geetha Jeevan, Honorable Minister for Animal Husbandry, Government of Tamil Nadu. Dr. Palaniyandy, District Collector of Tuticorin spoke on the occasion and Dr. N.G.K.Pillai, Director CMFRI delivered the presidential address. On the occasion, the village linked pearl culture program of TRC of CMFRI was inaugurated by the Honorable Minister by handing over 100 nucleated oysters to a women SHG from Vellapatti village near Tuticorin. The open house and exhibition was visited by nearly 4500 school children.

Smt P.Geetha Jeevan, Honorable Minister for Animal Husbandry, Government of Tamil Nadu inaugurating the open house and exhibition

कार्यकारी सारांश

भारत के समुद्र मछली उत्पादन में 2.8 मिलियन टन के साथ 6.3% की वृद्धि हुई। 5 लाख टन को पार करके *सारडिनेल्ला लोंगिसेप्स* मछली की पकड सब से अधिक मिली थी। समुद्र मछली उत्पादक राज्यों में केरल सर्वप्रथम स्थान पर और गुजरात इसके पीछे आए थे। क्षेत्रवार पकड में दक्षिण पश्चिम क्षेत्र पहले स्थान पर और उत्तर पश्चिम क्षेत्र इसके पीछे आए थे। समुद्री मछली अवतरण का आकलित मूल्य प्राथमिक स्तर पर 11% बढती के साथ 14,721 करोड रु. में और अंतिम बिक्री मूल्य 12% बढ़ती के साथ 24,934 करोड रु में चढ गया।

केरल से आकलित किए लंबे समय के शक्य फसल (LTPY) और औसत लंबे समय शक्य फसल (ALTY) 6.63 लाख टन के मद्दे मिला फसल 6.19 लाख टन था जो कि उत्पादन में वृद्धि की कम गुंजाइश दिखाती है। लक्षद्वीप की ट्यूना मछली पकड में वर्ष के दौरान कमी दिखाई पडी। तमिलनाडु की पकड साध्यता पर किए गए अध्ययन से स्पष्ट हुआ कि छोटी वेलापवर्ती मछली जैसे तारली का पकड प्रयास बढाने से उत्पादन बढ़ाया जा सकता है। आंध्र प्रदेश की कुल मछली पकड में मूलतः तारली, बाँगडा और फीतामीन की पकड में हुई कमी से 3.8% की घटती हुई। गुजरात में 6.5% घटती के साथ पकड की प्रवणता नीचे की ओर ही रही। घोल और कोथ मछली उत्पादन में नवजागरण होने के सिवा महासागरीय स्क्विड (*Sthenoteuthis oualaniensis*) की प्रचुर प्राप्ति देखनेलायक बात थी। महाराष्ट्र में 3.19 लाख टन अधिक फसल का उत्पादन हुआ, प्रतिशत वृद्धि 4.6 थी। यहाँ तारली के उत्पादन में पाँच गुणा और बाँगडे के उत्पादन में 2.4 गुणा बढ़ाव हुआ।

कर्नाटक के उत्पादन में 21% चढ़ाव हुआ। पर यह देखा गया कि 17 मछली जाति विभवों के विदोहन, अनुकूलतम स्तर के ऊपर, 6 का अनुकूलतम स्तर पर और सिर्फ दो का अनुकूलतम स्तर के नीचे, हुए थे। वेरावल, मुम्बई, माँग्लूर, कालिकट, कोची, टूटिकोरिन, मंडपम कैंप, चेन्नई और विशाखपट्टणम से मिली निम्नमूल्य की अनुपयोगी मछलियों की पकड का मूल्यांकन किया था। *डोबसोनी* झींगा के तरुणों के विदोहन से हुए आर्थिक नष्ट का आकलन किया था। उत्तर पश्चिम तट के पारिस्थितिक तंत्र के पोषण संबंधी मॉडल का विकास किया। अध्ययनों ने व्यक्त किया कि इस परितंत्र अपक्व और विकासोत्मुख है। यहाँ से व्यक्त हुआ उच्चतम माध्य पोषण स्तर (3.49) ने सूचित किया कि इस परितंत्र में परभक्षियाँ हावी हो गई है।

दक्षिण पश्चिम तट और अन्तर्राष्ट्रीय समुद्रों में बसनेवाले येलोफिन ट्यूना मछलियों पर किया DNA विश्लेषण ने सूचित किया कि आनुवंशिक रूप से ये समजातीय है। महाचिंगटों के परिरक्षण पर जागरूकता जगाने को गुजरात, महाराष्ट्र और तमिलनाडु के कृषकों के बीच उनकी प्रादेशिक भाषाओं में तैयार किए पोस्टरों और लघु पत्रिकाओं का वितरण किया। उत्तर आन्डमान की गहरा सागर तलमज्जी पखमछली की जैवविविधता का अन्वेषण करके कई सूचकांक तैयार किए।

वर्ष के दौरान समुद्री मछलियों और मात्स्यिकी में जलवायु परिवर्तन से होनेवाले प्रभाव और सह्यता संबंधी अध्ययन जारी रखा। समुद्र के बढते तापमान व प्रवाह के अनुसार बाँगडों का उत्तर अक्षांश की ओर प्रयाण और गहराइयों में अवरोह देखा गया। तारली मछली में भी समान प्रवृत्ति दिखाई पडी। समुद्र में मत्स्यन करनेवाले बोटों का कार्बन फुटप्रिंट निर्धारित किया। समुद्री सतह के चढ़ाव से तटीय मछुवा गाँवों पर होनेवाली क्षति का अध्ययन किया।

भारत के दक्षिण पश्चिम तट की समुद्र मछली संपदाओं की जैवविविधता की पुरानी डेटा के विश्लेषण अध्ययन करके बहुत ही सूचनाएं इकट्ठा की। बाँगडा और तारली की पकड संबंधी डाटा जो वर्ष 1926 से लेकर 2005 तक उपलब्ध थी, का विश्लेषण करने पर यह व्यक्त हुआ कि 1950 और 1990 के वर्षों में तारली का पुनरुज्जीवन हुआ जिसका संबंध बारिश और अनुकूलतम पर्यावरणीय जालक (optimal environmental window) से जोडा जा सकता है।

भारत के 8 तटवर्ती नगरों में घरेलू मलिन जल और मानवजन्य क्रियाकलापों से होनेवाले परिवर्तन का अध्ययन किया। पर्यावरण परिवर्तन से छोटी वेलापवर्ती मछलियों के वितरण में होनेवाले अन्तरण का अध्ययन किया। मछली प्रभवों के पहचान केलिए फिश ओटोलिथ कोमिस्ट्री टूल का प्रयोग बहुत उपयोगी पाया गया। समुद्री स्तनियों पर की गई परियोजना की अंतिम रिपोर्ट ने इनके स्थानिक और कालिक वितरण, मत्स्यन गिअरों में होनेवाली आकस्मिक मृत्युता, आण्विक वर्गविज्ञान, ऊतकों में विषालु धातुओं, रोगनाशियों का भार आदि पर प्रकाश डाला।

समुद्री मात्स्यिकी कारोबार हित-लाभ विश्लेषण परियोजना के अंदर केरल के 10 यान - संभार संयोजनों के परिचालन व्यय - लाभ का अध्ययन किया। एकल दिवसीय ट्रालिंग में विशाखपट्टणम की तुलना में काकिनडा में पूँजी उत्पादकता अधिक थी। तमिलनाडु के अल्लमताला ग्राम में हुई विस्मयजनक सामाजिक और प्रौद्योगिकीय परिवर्तनों का अभिलेखन किया। मात्स्यिकी अनुसंधान में प्रभाव निर्धारण पर लिखे अनुसंधान प्रपत्रों की तुलना NAAS rating से की गई।

अधोजल सर्वेक्षणों से दक्षिण भारक के प्रवाल झाडियों की वैविद्यता का प्रलेखन किया। इनायम में 3% और विषिंजम में 16% प्रवाल झाडी दिखाई पडी। मान्नार की खाडी में *तल्लुमाडी* और *शिंगुवलै* के प्रचालन से स्पंजों व महाचिंगटों का नाश होते हुए देखा। करंजिड के 21 वंशों में आनेवाली 61 जातियों को पहचानते हुए इसका जातीय और अवजाति वैविद्यता अध्ययन पूरा किया।

समुद्र कृषि केलिए योज्य संतति उत्पादन कार्य में *सेमिसुलकाटस* झींगा और *पेलाजिकस* केकडा की संततियों का हैचरी उत्पादन और समुद्र रैंचन किया। *फेरियाटस* केकडे का अंडजनन, स्फुटन और डिंभकपालन पहली बार सफलता से किए गए। शंबु पालन में 22% घटती देखी। सत्तारद्वीप में शंबु पालन की साध्यताओं का निर्धारण किया। विषिंजम और कालिकट में पंजरों और बाडों में पख मछली पालन शुरु किया।

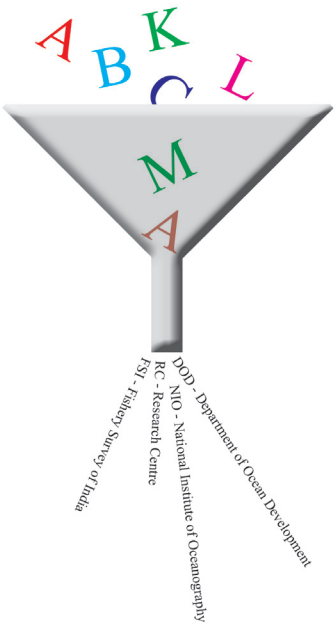
समुद्र मछलियों की खेती संबंधी प्रौद्योगिकी विकसित करने के तीव्र श्रम में 5 खाद्य मछलियाँ कोबिया, *एपिनेफेलस मलबारिकस*, ग्रूपर, राबिट फिश और पोम्पानो का पालन कार्य वर्ष के दौरान भी जारी रखा। समुद्री अलंकारी मछलियाँ सफेयर डेविल और रेड हेड डोटीबाक के अंडशावक विकास और प्रजनन में सफलता प्राप्त की। मारुन क्लाऊन मछली के डिंभक पालन तकनीक का मानकीकरण किया।

समुद्र जैवप्रौद्योगिकी में अलंकारी मछलियों को खिलाने का 2 खाद्य तैयार किया और आयातित खाद्य से इसकी कार्यक्षमता की तुलना की गई। खतरे में पडी दो शिंगट जातियों के आण्विक आनुवंशिक प्रोफाइलिंग और बयोमार्कर्स (biomarkers) का विकास किया। मलबारिकस ग्रूपर मछली के विविध ऊतकों से 7 सेल कल्चर सिस्टम (cell culture system) का सफल विकास किया। पख मछलियों और कवचमछलियों में बसनेवाले 3 रोगजनकों के पहचान केलिए डी एन ए मईक्रोअरे चिप DNA microarray chip का विकास किया।

वर्ष के दौरान संस्थान के वैज्ञानिकों द्वारा 15 विशेष प्रकाशन और किताब; अभिजात पत्रिकाओं में 33 अनुसंधान लेख और समुद्री मात्स्यिकी और मछली पालन पर बहु संख्यक लेख प्रकाशित किया गया। अपने प्रशंसनीय कार्य केलिए 8 वैज्ञानिक देशी व अन्तर्राष्ट्रीय संगठनों द्वारा पुरस्कृत हुए। वर्ष के दौरान 6 छात्रों को अपने अनुसंधान कार्य केलिए डॉक्टरी उपाधि प्रदान की गई।

संस्थान ने 60 लाख रुपयों की परामार्श परियोजनाएं चलाई जिन से 83 लाख रु कमाए। संस्थान के वैज्ञानिक बाहरी संगठनों से परियोजनाएं प्राप्त करने में कामयाब हुए। इन में लक्षद्वीप द्वीपसमुहों में ट्यूना पर्यवेक्षण पर प्राप्त परियोजना सब से बडी थी।

Acronyms Used



ADAK	Association for Development of Aquaculture in Kerala
ATIC	Agricultural Technology Information Centre
BFFDA	Brackishwater Fish Farmers Development Agency
CARI	Central Agricultural Research Institute
CIBA	Central Institute of Brackishwater Aquaculture
CIFA	Central Institute of Freshwater Aquaculture
CIFE	Central Institute of Fisheries Education
CIFT	Central Institute of Fisheries Technology
CMFRI	Central Marine Fisheries Research Institute
CoF	College of Fisheries, Mangalore
CUSAT	Cochin University of Science & Technology
DBT	Department of Biotechnology
DOD	Department of Ocean Development
DST	Department of Science & Technology
E	Exploitation Rate
FAO	Food and Agricultural Organisation
FSI	Fishery Survey of India
GAU	Gujarat Agricultural University
GOPL	GMR PSEG Operations Private Limited, Mangalore
IASRI	Indian Agricultural Statistics Research Institute
ICAR	Indian Council of Agricultural Research
IFS	International Foundation of Science
IGIDR	Indira Gandhi Institute of Development Research
IOTC	Indian Ocean Tuna Commission
ISD	Information System Development
IVLP	Institution Village Linkage Programme
KIOCL	Kudremukh Iron Ore Company Limited
KKV	Konkan Krishi Vidhyapeeth
MOES	Ministry of Earth Sciences
MOE&F / MEF	Ministry of Environment & Forest
MPEDA	Marine Products Export Development Authority
MRPL	Mangalore Refineries and Petrochemicals Limited
MSY	Maximum Sustainable Yield
NAARM	National Academy of Agricultural Research Management
NABARD	National Bank for Agricultural and Rural Development
NBFGR	National Bureau of Fish Genetic Resources
NGOs	Non-Governmental Organisations
NIO	National Institute of Oceanography
RC	Research Centre
RGCA	Rajiv Gandhi Centre for Aquaculture
RGCCS	Rajiv Gandhi Chair for Contemperory Studies
SEAFDEC	South East Asian Fisheries Development Centre
SFDs	State Fisheries Departments
TANUVAS	Tamil Nadu Veterinary and Animal Science University
WFC	World Fish Centre
Z	Mortality Rate

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